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SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

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Look! then write your own title

THE siren scream on city street or the pound of hammer on the rural engine tire—both shout the same warning to all building owners "*Look out for flying embers on your roof*" for every roof within earshot is in immediate danger—and even those that are well out of hearing are still within the fire circle once a fanned ember gets into the upper air currents. Jumps of one, two and even three miles are given in the fire records. So that the roof-communicated fire does not depend on the adjoining property for fodder. In the Atlanta Conflagration three widely separated fire centers were noted shortly after the initial blaze—roof-communicated all; and $5,500,000 was the charge that the National Board of Fire Underwriters made against the inflammable roof in this one fire.

Thus the urge for fire-safe roofing is a very real one because every house is all roof to the fire-brand—make the roof all-mineral—with Johns-Manville Asbestos—and this big cause of conflagrations is killed right there.

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIV. NUMBER 16] NEW YORK. APRIL 16, 1921 [15 CENTS A COPY 20 CENTS IN CANADA

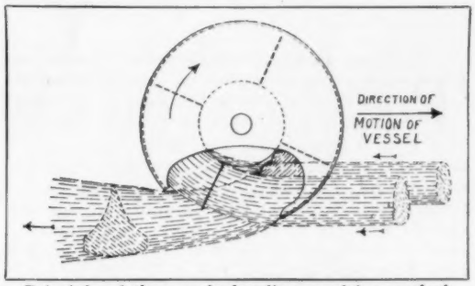
A New Form of Hydraulic Propulsion

SO far as the records go, it is well established that the idea of propelling a vessel by means of a rearwardly discharged jet of water is very old. Indeed, we are told that the first definite proposal of this kind was made by John Allen in 1729. The required stream of water was obtained by means of an early engine of the Savery type. In 1866 the British Admiralty equipped the "Waterwitch," of 1,160 tons, with a hydraulic propulsion system, patented by John Ruthven. The results were discouraging. Then, in 1881, Sir John Thornycroft developed Ruthven's plan in a small torpedo boat of 14½ tons, securing a speed of only 12.6 knots, as compared with 17.3 knots obtained by a similar boat driven by a propeller. During the war it was realized that hydraulic propulsion, because of its comparative silence, would be a suitable drive for vessels engaged in submarine hunting. Each vessel built for this work was fitted with a pair of centrifugal pumps which drew water from a forwardly-pointing tunnel outside the skin of the ship, and discharged it through another tunnel pointing aft.

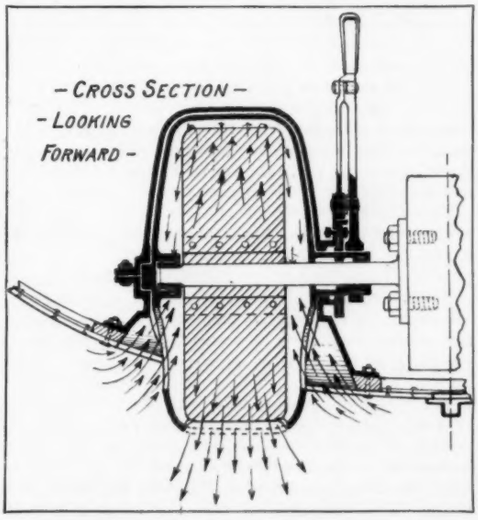
For these facts and for the illustrations which accompany this article we are indebted to *The Engineer*, of London, which gives considerable space to the description of what is known as the Hotchkiss system of hydraulic propulsion, so named after the inventor, Mr. Donald V. Hotchkiss, Associate Member of the Institute of Naval Architects.

Our drawings, which are based on those which appeared in the article referred to, will help to make clear the following description of this interesting experiment. The system is shown as fitted in a weldless steam launch which has a draught of one foot five inches, and a displacement of two tons. The motor develops eight horsepower at normal load, and is coupled through reduction bevel gearing to two Hotchkiss pumps. The engines run at 900 revolutions, and the pumps at 270. Each pump delivers a stream of water 24 inches in cross sectional area, at a speed of 15.4 feet per second, the result of the rearward discharge being about 9½ tons per minute. This means that in 12½ seconds, the pumps can discharge a weight of water equal to the displacement of the vessel.

The general principle of the system, as shown in our diagram representing the flow of the water pumps, of which there are two, one on each side of the keel, consists of a four-bladed impeller, which rotates within a cylindrical casing, in the lower part of which are formed three openings, one on each side and one in the periphery. In the diagram the strips that separate these holes are shown as having been cut out. It will be noted in the cross-section of the pump that the casing is considerably wider than the blades, leaving on each side of the blades a passageway of considerable area. In the diagram the boat is moving toward the right, and the impeller is being driven clockwise, as shown by the arrow. Its rotation creates a vortex within the casing. The water is drawn into the casing through the side holes, and once inside the two inflowing streams converge into one, which passing centrally between the two entering streams, is discharged toward the stern of the boat. The broadly triangular shape of the discharge stream should be noted.



Principle of the new hydraulic propulsion method



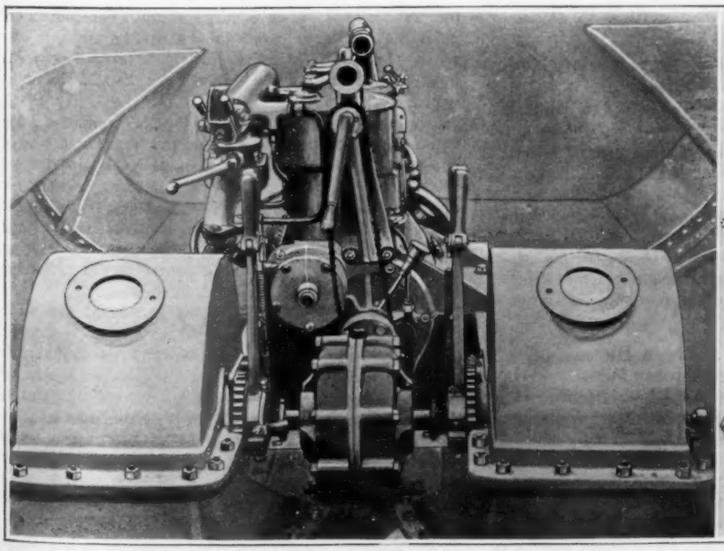
Cross-sectional view of one of the pumps, showing the stream flow

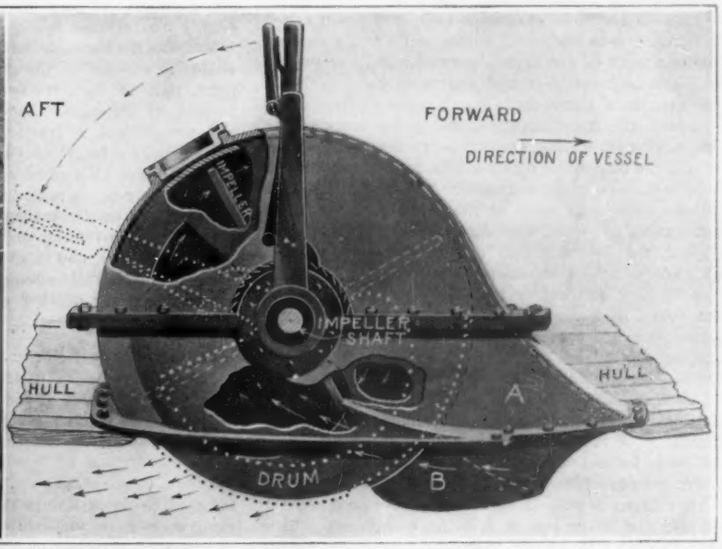
Referring to the cross-section of the pump it will be seen that the casing contains an internal drum, mounted upon the impeller shaft, and fitting fairly closely to the casing. The drum, in its lower half, extends somewhat below the bottom of the vessel, and it is provided, as noted above, with two side openings and one in the periphery. The outer casing completely encloses that part of the inner drum which lies above the center line of the impeller shaft. Below this line the outer casing flares to a junction with the skin of the hull to which it is fastened.

Referring to the side view it will be noted that the casing in the neighborhood of its forward end is swept forward to form an inflow passageway, *A*, the mouth of which opens just below the outer skin of the hull. The under portion, *B*, of this extension is simply a stream-lined filler, which fills the space between the outer wall of the passageway and the periphery of the internal drum, and provides for an easy flow of the outside water.

In the position shown in the side view, the peripheral opening of the internal drum is completely open to the water, and it forms the orifice through which the stream of water is discharged rearwardly from the impeller. The inlet stream of water which enters

(*Continued on page 315*)





Left: **Hydraulic equipment, consisting of a 7¾ horsepower engine and two pumps.** ***Right:*** **Side elevation of a pump, showing the outer casing and inner drum, the impeller, and the inlet and discharge**

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Tidal Power in France

IT is possible to say that, even in an economical sense, the great war was not all loss; for out of the colossal destruction and soaring costs has grown a demand for a more thorough utilization of certain natural resources which have been hitherto neglected. Before the war the world had become adept in the utilization of the water power of rivers and streams; and present indications are that this source of power is about to be exploited on a scale that has never yet been attempted. Several such developments, indeed, are already under way. An absolutely new source of power, however, is the utilization of the ocean tides—new, not in the sense that the subject has never been talked and written about, and even in a crude way made the subject of experiment, but new in the sense that the problem is now about to be grappled with on a large scale and with all the resources of governmental finance behind it. The biggest of these projects, at the mouth of the River Severn, we have recently illustrated in this journal; and now comes an announcement from France that the French government is about to develop the tidal power at the mouth of the picturesque River Rance, which finds an outlet at the quaint old town and harbor of St. Malo—one of the points of debarkation for our American troops, by the way, which will dwell long in the memory of many of our soldiers and sailors that went to the Great War. The tide at St. Malo has the great rise of thirty feet, and the local topography of the place should be favorable to an economical construction of the necessary dams to impound the water. The system will be of the double-flow type—that is to say, the turbines will operate both on the inflowing and the outflowing tide.

Ventilation in Motor Vehicle Tunnels

THE engineers of the New York and New Jersey State Bridge and Tunnel Commission are to be commended for the thoroughness with which they are investigating the question of ventilation in vehicular tunnels. There is nothing new about the construction of this tunnel. It is a straight job of civil engineering, and it will be well done. But the construction of a tunnel of this length to carry a dense automobile traffic is altogether new, and the question of ventilation is absolutely fundamental to its success. The engineers of the tunnel have engaged the Bureau of Mines to investigate and report on the ventilation problem. In a report made last November, the Bureau answered the questions, first, as to the amount and composition of exhaust gases from motor vehicles; and second, the amount of dilution with fresh air necessary to render such gases harmless. The investigation of exhaust gases was made at the experiment station at Pittsburgh on over one hundred automobiles and trucks; the determination of the necessary dilution with air for human consumption was carried out in the Physiological Laboratory at Yale University, when it was found that after the students had been subjected to one hour's exposure to air whose carbon monoxide compound did not exceed four parts in 10,000, no noticeable symptoms of discomfort appeared.

The Bureau of Mines is now engaged in determining the most efficient method for sending the necessary quantities of air through the tunnel. This investigation is to be carried on at the University of Illinois, where an experimental duct 100 yards in length and similar in cross section to the air ducts proposed for the Hudson River tunnel is being constructed. This investigation will supply valuable information on the question of the friction of the flow of air in concrete ducts of various contour. Not alone will the investigation answer the questions which are being asked regarding the Hudson River tunnel, but it will provide data that will be of great use to the mining engineer, who is making increasing use of concrete construction. The Bureau of Mines at Pittsburgh, furthermore, is building an experimental tunnel in which a final and conclusive test will be made, based upon the data already secured. The tunnel, which will be oval in shape, will be built with air ducts similar to those in the Hudson River tunnel. It will extend for a length of 400 feet and the cross section will be large enough to permit a single line of automobiles to run through the tunnel under the usual headway. In this, the final test, it will be possible to determine the diffusion of the exhaust gases, the temperature conditions, as affected by the motors, and the full physiological effects of temperature, exhaust gases, and smoke, under actual operating conditions.

Cutting Down Transportation Costs

THE so-called container type of railroad car, recently illustrated in our columns, has now been sufficiently long in service to enable the New York Central lines to give some definite figures as to the saving effected by this very sensible device. The steel express car, with nine portable containers, has made several successful trips between this city and Chicago with the Twentieth Century and other fast trains. The company is satisfied that the new car will save demurrage, truckage and clerk hire, and will prevent large losses by theft. The system, it will be remembered, provides a compartment service by means of containers which, in effect, provide for shippers the use of individual traveling safe-deposit vaults of various standard sizes. When these containers have been loaded and locked they are carried intact from the door of the sender to the door of the receiver of freight. They are transferred from factory to train and from train to store door of the consignee either by motor truck or electric car. On delivery they are unlocked and unloaded at the convenience of the consignee.

Now the significance of all this is seen when we are told by the railroad people that loss and damage of freight has grown in recent years to one of the heaviest leaks in transportation, and that for its prevention the railroads have to maintain a police force and carry on educational campaigns among shipping and railroad employees to secure better packing, more careful handling, and the suppression of theft. That all this effort has failed to stop the economic waste is shown by the fact that in the year 1914 the American railroads paid out in claims for loss and damage of freight 33 million dollars, and that in 1920 this had grown to the stupendous total of 125 million dollars. As the result of the recent tests, the New York Central is of the opinion that the large economies effected by the new lock-safe system of transportation, such as prevention of loss and damage of freight, saving in wages and those due to the cheaper and lighter boxing and crating now possible in the case of individual small shipments, great as they are, will be exceeded in amount by the greater use of moving equipment, railroad cars, trucks, et cetera, due to the new method of shipment. Container cars can be loaded and unloaded in a fraction of the time required for hand truckers to fill or empty a box car of miscellaneous articles at a platform.

The railroads are making heroic efforts, just now, to cut down the cost of transportation. They scored their first success in raising the average load per car by a large percentage, and if, as seems likely, the container-car shipment for miscellaneous freight becomes general, we may look for another great reduction in the costs of operation.

The Navy Should Have a Bureau of Aeronautics

THE activities of the Navy Department are carried on under a system of separate bureaus, each of which is confined to certain specific work. Thus, the Bureau of Construction and Repair designs the hulls of the ships; the Bureau of Steam Engineering designs the motive power; the Bureau of Ordnance designs the guns, and so forth; and each of these is in charge of a director, or chief, who directs and is responsible for the work done in his own particular bureau. This segregation of the multiplied activities of the Navy has not been an arbitrary matter; rather, it represents a natural growth in which the institution of separate bureaus has been rendered necessary by the multiplication of inventions and discovery and the ever-increasing complexity of the modern warship. In fact, the bureau system finds its counterpart in that specialization which is such a marked feature of our modern industrial activity, where the growth of each particular branch of industry has been so rapid and has so greatly widened the field of knowledge, that it is all that one man can do to get a thorough mastery of one particular field.

The birth and rapid development of the new art of aeronautics and the important part which it is bound to play in future naval warfare have brought the Navy Department face to face with the question as to whether it must not now create another bureau to deal with what is already a highly specialized branch of naval activity. Even today, when we stand merely on the threshold of aeronautical development, the art is sufficiently developed to call for the services of a highly specialized class of men in the designing room, in the work shop, and in actual flying service with the fleet at sea. What we already possess in the way of machines, men and knowledge is merely a beginning, and it is certain that the call for a special bureau will become more insistent as the years pass by.

There is a powerful movement at work in favor of the institution of a United Air Service, in which the design and construction of machines and the training of officers will be done under a single central body, and the machines and the men allocated to the Army or the Navy in response to the demand. Personally, we believe that the Army service on land and naval service at sea are so widely different, both in the character of the machines required and in the training of the personnel, that no greater mistake could be made than to include the two branches in one central service.

In the first place a machine that is suitable for land service is not suitable for the sea. The conditions are widely different. Given a fairly level and smooth field, the Army plane can take off and land upon it no matter in what part of the world the landing field be situated; but for sea service you must have a plane which can take off from or land upon the sea itself or upon the unstable platform of a ship which has been built especially for that purpose. Furthermore, not only must the naval aircraft be designed for these special conditions, but the flying man, to be thoroughly efficient, must have been bred to the sea. He must have acquired that sea instinct and initiative which is the mark of your efficient naval man and is every whit as essential to the officers and men who navigate in the air as to those who navigate upon the surface of the sea. The air squadrons of a great fleet must be trained to operate with that fleet and find their proper position in it just as completely as a battle-cruiser squadron, a cruiser squadron, or a flotilla of destroyers and submarines. They must know their commander-in-chief, be familiar with his tactics, and be on their toes all the time, ready almost to anticipate the orders which long familiarity and training have taught them to expect.

To put the flying activities of the Navy under a separate outside organization such as the Army or a United Air Service, would be as efficient as to have a United Bureau of Ordnance and have the Navy constructor send the sketch plan of the proposed armament of the ships to such a body, with the request that they design the suitable guns, gun mounts, projectiles, ammunition hoists, and what not. Such a course would make for errors, misunderstandings and inefficiency.

Hitherto the development of naval aircraft has been everybody's task and the task of no one in particular. The immediate need of the Navy is a responsible directing bureau in the Navy which can care for naval aviation and foster its growth and development. Unless we have such a bureau, aviation will continue to stagger along and we shall be faced with a repetition of the failures which have been all too frequent in our submarine development.

The idea of coordination, as expressed in a United Air Service, is attractive as an abstract proposition. Great Britain thought so—tried it out—and has abandoned the idea as impracticable.

Electricity

Equipment for 220,000-Volt Transmission. — There have just been completed for a California electric company a number of transformers and accessories to be used on the world's first 220,000-volt power transmission system. The total weight of each transformer is 50 tons, including oil. The height from rail to top of bushing is 24 feet, and the diameter is 10½ feet.

Compressed Air Cleaner for Electrical Machinery.— If compressed air is available, there is no better way to clean electrical equipment such as generators and motors than with a newly-developed cleaner. This is a device which is clamped directly to the air hose, and is provided with a quick-acting hand valve that gives complete control. The shape of the cleaner is such that it can reach in otherwise inaccessible places.

A New Method of Manufacturing Nitrogenous Compounds has been developed and placed in operation in Sweden. The method, which is an electrochemical process has many points of resemblance with the Haber process, but is said to be more economical and reliable. Heating is effected by electricity, and according to the statements made before an engineering body at Gothenburg, some 22 pounds of combined nitrogen can be made with the consumption of 12 kilowatts.

Hydroelectric Development in Italy. — From Commercial Attache H. C. MacLean we learn that during the war, in spite of the shortage of labor and the difficulty in obtaining equipment, hydroelectric development in Italy made rapid progress. It is estimated that whereas in 1915 Italy's electric power resources amounted to 2,500,000,000 kilowatt hours per annum, this figure had been increased to 3,700,000,000 before the end of the war, and now approximates 4,000,000,000. The capital of Italian electric companies now reaches about 1,500,000,000 lire.

Radio Railroad Signals.—A new signaling system making use of radio waves has been developed in Germany. The transmitting apparatus is placed on the locomotive with the loop antenna so suspended from the underside as to cause electric waves to be radiated toward the permanent way. At points of the road where signals are to be given to the train there are tuned circuits made up of loops, the characteristic waves of which are identical with the wave length of the transmitter, continues *Wireless Age*. A visual signal within the locomotive cab gives well-defined indications when the track devices are passed.

Telephoning Over Lighting Mains.—In a brief note communicated by the technical commission of the French Syndicate of Producers and Distributors of Electrical Energy, a device is described by the aid of which a line between a generating station and a substation may be utilized both for telephone communication between the two stations and for lighting, heating or storage-battery-charging purposes. The line is normally connected for power service, continues *Electrical World*, but as soon as the receiver is lifted off the hook on any telephone apparatus on the system the line is disconnected from the power supply by means of relay operated breakers and connected to the telephone system.

Wooden Masts for Radio.—Wooden structures have many advantages over steel, giving as they do a greater effective antenna height and absorbing less power in eddy current losses, according to constructors of such masts. They permit the installation of a smaller generating plant, with consequent reduction in capital outlay and annual charges, or, alternatively, the employment of smaller masts to communicate over a given distance. These masts are economical to erect as suitable material is usually available near the site. When properly erected, they have the greatest stability. A large number of the Elwell type masts, from 300 to 714 feet in height, have been erected, and not one has failed.

Electric Power from the St. Lawrence. — A plan has recently been brought to the attention of the engineering fraternity, calling for the harnessing of the St. Lawrence River in order to develop some 5,000,000 horsepower of electrical energy, and to provide a 30-foot waterway for freight that must be transported between the Great Lakes and the Atlantic Ocean. The proposed development involves the construction of five dams with a generating station at each end of each dam. This arrangement is essential to the handling of the great ice floes of the St. Lawrence. The logical dam to construct first would be that at Croil Island, about 33 miles below Lake Ontario; the second would be located near Massena Point, N. Y., about 15 miles downstream from the first; the third would be about 44 miles farther along, near Cedars, Quebec; the fourth about 4½ miles below, near Cascades Point, Quebec, and the fifth about 20 miles downstream, near Côte St. Paul, Quebec. About 40 feet of head would develop at each point, the aggregate being 196 feet.

Science

National Parks Protected from Power Grabs.—Commercial dams and power houses can no longer be constructed in our western national parks. The hand of the spoiler has been stayed by Congress.

The Equinoctial Storm Has No Basis in Fact.— That the equinoctial storm is a myth is demonstrated by an astute coöperative observer of the U. S. Weather Bureau. This popular belief is probably the result of early teaching handed down from father to son. Old weather saws are very hard to eliminate.

Roger Bacon's Cipher Manuscripts.—A discovery of cipher manuscripts of Roger Bacon show that he was familiar with the use of high-powered microscopes and telescopes. A key to the code was discovered by Dr. Newbold of the University of Pennsylvania. Many of the results of modern science are said to have been anticipated. Fuller particulars will be given to the world shortly.

Paris War Library.—Over 100,000 volumes and almost as many pamphlets, etc., have been collected by the French Government and a building will be erected having five miles of shelving. The future historian will probably die in the first mile. The collection of manuscripts, photographs and war records is appalling as to numbers, and there seems to be no limit to the gifts of collectors. In this country Princeton University and the University of California are especially strong on war material.

Americans Like Milk. — The average American is becoming a confirmed milk drinker. He consumes twice as much as in former generations. The consumption of milk per capita was 44 gallons last year, without counting up dairy products such as butter, cheese and ice cream. While milk is not very cheap at the present time, owing to the cost of labor, railroad charges and the scarcity of brewer's grains, still the present-day facilities of obtaining milk in prime condition is largely responsible for the increasing use.

China Had a Zoo in 11 B.C. — We find that the Chinese were always to the forefront in ancient days when anything scientific is concerned. They started a "Zoo" in 11 B. C., only they called it an "Intelligence Park." The ancient Greeks and Romans were fond of seeing strange animals, but they do not appear to have collections as such, the gladiators getting most of them. The modern zoological gardens had their origin during the middle ages when feudal magnates and royal persons had menageries. In the middle of the fifteenth century there were zoological gardens, aviaries and fish ponds in Mexico.

Salvarsan Profits for Science.—The sum of $500,000 has been made over to the Dermatological Research Laboratories in Philadelphia by Doctors Schamberg, Kolmer and Raizess, being the profits received by the laboratories during the war from the sale of the drug arsphenamine, a substitute for "salvarsan." Its manufacture was the result of experiments carried out by these noble-minded professors. Once more American science has won a chemical victory and the domestic article which was so sorely needed was sold for one-third less than the greedy German manufacturers demanded and now even the profits go to science.

Free Asphalt in the Gulf of Mexico.—Our asphalted streets are so expensive that the very thought of "free" asphalt even though it is in the Gulf of Mexico is refreshing. Along the coast of Texas have been found thousands of tons of fresh asphalt in floes like ice and of varying thickness. The phenomenon of asphalt appearing in the beach surf revives stories told many years ago by coast residents of similar occurrences, long before the discovery of the Tampico oil fields. The theory has been advanced in the past that the asphalt originated from some section of the bottom of the gulf through an earth disturbance causing emissions of the substance from an underlying deposit.

Twentieth Century Manna.—Our Consul in Jerusalem states that manna is found now in the regions of upper Mesopotamia and Kurdistan and along the Persian frontier. It falls, he says, in the form of dew during September, October and November, and lodges upon the leaves of oak trees. It immediately hardens and assumes the form of a grain. Early in the morning before the heat of the day it is gathered by spreading sheets beneath the trees, which are shaken, and the manna is then collected and stored for winter to be used as a food or shipped to Bagdad for sale in the bazaar. The manna falls on other vegetation, including grass, but all of it is lost except that which is gathered from the oak leaves. The manna is sweet and is eaten by the natives as a substitute for sugar or honey.

Industrial Efficiency

The Wood Split Pulley continues to hold its own ever since its introduction some forty years ago. This type of pulley is claimed to be lighter and more carefully balanced than any metal pulley; the tractive pull of a belt on a wood rim is greater than on an iron or steel rim; and the buyer can generally expect a quicker delivery of both stock and special sizes.

Another Victory for Machinery. — From Lyon, France, comes the report that a machine has been developed for making raised embroidery in gold and silver. It is stated that the stitch is a copy of an ancient form of embroidery and gives an impression of handwork, and is also the first machine that has been successful in using the metallic thread. Various machines have been employed in the making of raised embroidery in other threads. It is stated that the machine is the result of seven years of study, and that the results are very satisfactory.

Cascara Bark. — A shipment of five tons of cascara bark from the coast valleys of British Columbia has revealed the fact that the only known supply of this valuable medicinal bark, in large quantities, is in British Columbia, the forests in Washington and Oregon having been completely stripped. Owing to the depredations of Japanese loggers, who ship to American and British drug firms, this valuable provincial asset is in danger of being exterminated, and steps are being taken to protect this valuable herb in order that it may be properly cultivated and in time become an established industry of British Columbia.

France's Hunt for Timber. — Numerous practical experiments have been made by the French Government in order to determine the resistance and durability of the various woods obtainable in French colonies. Contrary to the general belief, the timber which abounds in the colonies is not the hardwood employed by cabinet makers but common varieties which are adapted to ordinary construction purposes. A uniform commercial name has been given to the many varieties of timber which are closely related from a botanical point of view and suitable for the same purpose. The timber has been divided into categories according to its character and the purposes for which it may be utilized.

Firelighters from Clay. — The manufacture of a firelighter from clay deposits found on his land is being undertaken by a farmer in Saskatchewan. This deposit is the only known one of its kind on the American continent, although considerable quantities of this clay are also found in Germany. The firelighter is in the form of a brick. It is soaked in kerosene for a few minutes, and when it has absorbed a quantity a match is applied. The brick will burn for a half hour with a steady flame, and when exhausted can be replenished with kerosene and used indefinitely. Other uses to which this clay can be put are: Kalsomine, filler for paper, cleansing powders, white shoe polish, and brick or tile of the very best quality.

By-products from Apples.—What may prove to be a very valuable discovery has been made at Annapolis, Nova Scotia, in a method of extracting valuable by-products from waste and otherwise useless apples. It has been found that even the most intensely acid and usually worthless apples may be so treated by a simple process as to yield syrup which has been pronounced eminently desirable as a basis for other concoctions not hitherto so well supplied. And not only is this syrup valuable but another by-product has become evident in deposits of calcium malite, the same article as is derived from maple syrup and known as sugar sand. Before the war the Germans bought this up extensively in Quebec at $150 or more per pound, as a source of malic acid. The process is being treated in two evaporators, and may lead to the development of an entirely new industry in Nova Scotia.

Effect of Shorter Hours on British Output.—The annual report of the Chief Inspector of Factories and Workshops for 1919, just issued, disclosed the fact that along with the general adoption, without legislative compulsion, of the reduced 48-hour week, which was accomplished in most British industries during the war period, there has been a coincident decline in the rate of production. The experiences of different trades vary quite considerably. The average total number of hours of labor per week throughout the industries of the country as a whole amounts now to 47 or 48; in fact, in some factories, it has been reduced to 44 or less. This weekly working time is variously distributed according to the local practice, usually determined by a majority of the workers themselves through (1) the five-day week (with no work on Saturday), (2) the single-break day (with only one stop for meals), (3) the double-break day (with two meal times, or, (4) the shift system, with modifications.

Germany's Brown Coal

How Teuton Chemists Have Converted the Lowly Swamp Muck Into an Industrial Cinderella

By Robert G. Skerrett

FOR decades brown coal in Germany was generally considered scarcely better than peat for the generation of heat, and was used sporadically by people who dug it for their own consumption because black coal was not available or cost too much for their modest purses. Broadly stated, brown coal may be termed bituminous coal in the making—vegetable matter which has not been subjected to the compression and the high temperatures that brought about the formation of the well-known combustible. As brown coal comes from the ground it resembles woody, half-dried peat or muck such as may be found in many swampy forests. Before it is dried the stuff may be cut easily, and when dry the fibrous matter is apparently no more carbonized than the wood so often present in peat beds. The lignite, for such the fuel really is, is certainly unpromising when first dug, for its average moisture content is about 60 per cent; and when most of this water has evaporated the material tends to crumble. This affects both its keeping and its burning qualities, more especially if the ordinary grates are used.

Offhand, one might be justified in the assumption that no nation, until hard put to it, would take any serious steps toward exploiting a fuel that seems to have so little to commend it. Yet, back in the "nineties," the Germans saw possibilities in their widespread and well-nigh inexhaustible deposits of brown coal, and with typical Teuton thoroughness evolved, in a comparatively short while, ways and facilities by which the initially indifferent combustible could be transformed into a fuel of undeniable merit. They did this by a briqueting process; and from a friable, unstable commodity, they made a product that would stand rough handling and endure exposure to the weather for months without disintegrating. Right here let it be emphasized that Germany's brown coal is much inferior in fuel value to most of the lignites that prevail abundantly in certain sections of the United States.

The U. S. Bureau of Mines has kept in touch as far as practicable with what the Germans have been doing in utilizing brown coal, and the data gathered is suggestively of great value. From the facts garnered by our experts it is not hard to realize why the Teutons are undismayed by their enforced separation from the bituminous coal fields which were formerly under their control. The brown coal lies in beds having a vertical thickness ranging from 32 to 328 feet with an average of 72 feet. The deposits are overlaid by relatively thin strata of gravel and clay, and this overburden is removed to facilitate the mining of the coal by open-cut methods. The gravel and clay are cleared away by steam shovels which dump the stuff directly on to cars that carry the spoils to banking grounds. Not infrequently, clay-working plants are operated close by and employ the brown coal for fuel.

When a satisfactory area of the brown coal has been exposed, movable rails are laid and powerful excavating machines of the chain-and-bucket pattern are advanced on them to the desired points of action. There the face of the cut is attacked at an angle of from 45 to 50 degrees, and each machine disposes of a slice of lignite to a depth of 43 to 49 feet. The succession of sharp-edged buckets, trailed by an endless chain, dig into the exposed slopes of the beds as they are dragged from the bottom to the top of the excavation. The buckets empty into hoppers from which the brown coal is loaded into small cars having a capacity of 1.3 cubic yards. One mechanical excavator, calling for the attendance of only three men, can cut about 1,650 tons in the course of 24 hours. The filled cars are drawn by locomotives to a station where they are attached to a chain belt which pulls them up an incline to the upper floor of the briquet factory. When the excavations reach still deeper, the chain-tractor system is extended to the terraces adjacent to the steam diggers, and the laden trams are then hauled right from the pits without the aid of locomotives.

One of the best examples of a brown-coal briqueting plant is that at Zisselsmarr, in the neighborhood of Cologne. It is a substantial brick structure placed close to the pit, and is typical of kindred factories reared at numerous points throughout the lignite fields of Germany. The establishment is supplied daily with 800 carloads of the raw material, each load weighing 1,320 pounds.

The lignite is passed through one or two pairs of crushing rolls and is screened by inclined vibrating sieves, and such of the stuff as still remains coarse is carried through a third crusher. The woody parts and hard lumps which will not drop through any of the sieves are taken by a belt conveyor to the boiler furnaces and there burned. In the course of ten or twelve hours enough brown coal is crushed and screened to supply the briqueting machines for a period of twenty-four hours. One man can look after the functioning of two sets of sieves.

The duly crushed, fine, moist lignite is distributed by belt conveyors to bins near the driers. The driers are sheet-iron cylinders 23 feet long and 10 feet in diameter, supported on trunnions and mounted longitudinally at an angle of 7 degrees from the horizontal. Each drier contains an inner cylinder carrying more than 360 four-inch tubes set parallel with the axis of that drum. Exhaust steam from the plant engines circulates around the tubes through which the damp coal is moved continually under the impulse of spiral feeders. The speed at which the ground material travels through the drier depends upon its moisture content. When this is 60 per cent the passage takes about 45 minutes; and during that time the moisture is reduced to 15 per cent. There are several driers, and each has a capacity of 77 short tons of dry lignite every twenty-four hours. It is said that the air in all parts of the establishment is substantially free from floating dust by reason of certain precautionary features, and this effectually obviates any risk of dust explosion—a danger that was not absent from some of the earlier briqueting factories. Before the war the drying cost was 17½ cents per ton of product.

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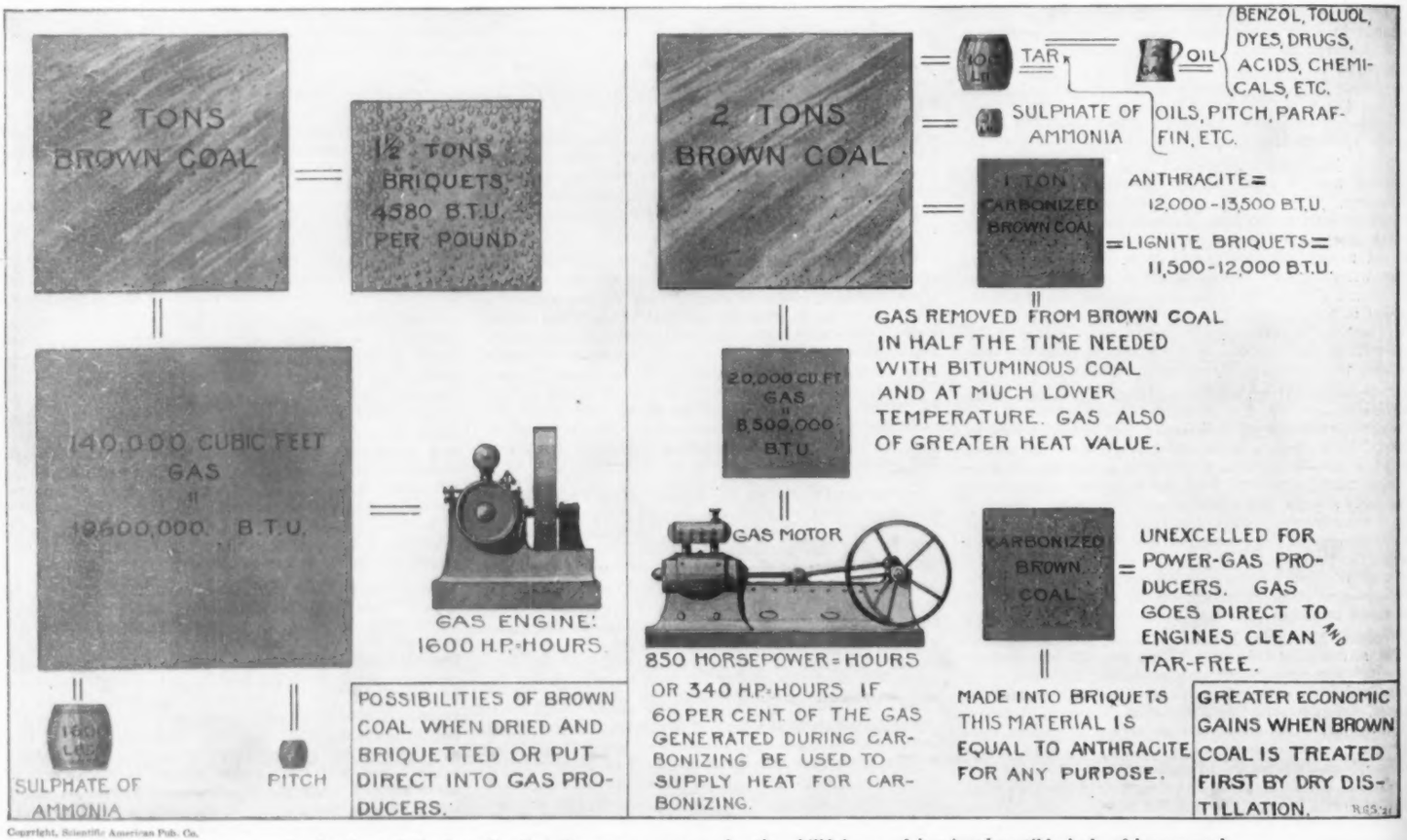
2 TONS BROWN COAL
1½ TONS BRIQUETS 4580 B.T.U. PER POUND
140,000 CUBIC FEET GAS = 12500,000 B.T.U.
GAS ENGINE: 1600 H.P.-HOURS
SULPHATE OF AMMONIA
PITCH
POSSIBILITIES OF BROWN COAL WHEN DRIED AND BRIQUETTED OR PUT DIRECT INTO GAS PRODUCERS.
2 TONS BROWN COAL
TAR
OIL
BENZOL, TOLUOL, DYES, DRUGS, ACIDS, CHEMICALS, ETC.
SULPHATE OF AMMONIA
OILS, PITCH, PARAFFIN, ETC.
1 TON CARBONIZED BROWN COAL
ANTHRACITE = 12,000-13,500 B.T.U.
= LIGHTITE BRIQUETS = 11,500-12,000 B.T.U.
20,000 CU. FT. GAS = 8,500,000 B.T.U.
GAS REMOVED FROM BROWN COAL IN HALF THE TIME NEEDED WITH BITUMINOUS COAL AND AT MUCH LOWER TEMPERATURE. GAS ALSO OF GREATER HEAT VALUE.
GAS MOTOR
850 HORSEPOWER = HOURS OR 340 H.P.-HOURS IF 60 PER CENT OF THE GAS GENERATED DURING CARBONIZING BE USED TO SUPPLY HEAT FOR CARBONIZING.
CARBONIZED BROWN COAL
UNEXCELLED FOR POWER-GAS PRODUCERS. GAS GOES DIRECT TO ENGINES CLEAN AND TAR-FREE.
MADE INTO BRIQUETS THIS MATERIAL IS EQUAL TO ANTHRACITE FOR ANY PURPOSE.
GREATER ECONOMIC GAINS WHEN BROWN COAL IS TREATED FIRST BY DRY DISTILLATION.

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Diagrammatic showing of the benefits that Germany can reap by the skillful use of her inexhaustible beds of brown coal

From Brewing Beer to Raising Mushrooms

By M. A. Henry

OF all the myriad problems growing from prohibition there is none more baffling than what to do with the breweries. Aside from the making of "soft" drinks, for which there is but a limited demand, there seems to be no good use to which the plant and equipment of a brewery are fitted. Worse, the expert training of the personnel is equally useless. But the owner of a famous old brewery in New York City believes he has found an answer; and the answer is—mushrooms!

It may seem, at first thought, to be a far cry from beer to mushrooms. But a closer examination of the facts reveals a rather intimate connection. The process of making beer is largely one of growing a species of yeast cells in a liquor obtained from malt and hops. Yeast is a first cousin to the mushroom; each is a colony of cell growths from the same family tree, and the cell growths are propagated best under similar conditions. Thus the brewing plant, with its refrigerating machinery and dimly lighted interior is admirably suited for the growing of mushrooms when growing frames have been substituted for the beer vats. Furthermore, the expert knowledge of the master brewer is entirely useful in preparing the mushroom spawn for the beds and in controlling the growing conditions.

This does not mean that brewers are assured of success as mushroom growers without studying the new subject, or without experiment; but if proper precautions are taken there is every prospect of success. In the one brewery where the plan has been given a thorough test, although in the heart of New York City, the "mushroom plantation" bids fair to surpass in fame and profits the plant's record as a brewery.

Being fond of mushrooms as a table delicacy and having experimented in their culture, A. G. Hupfel, Jr., decided not to let his big plant be submerged in the tidal wave of prohibition, but, instead, to turn it to account in this unique undertaking. He called to his assistance a man who has had thirty years' experience in developing the mushroom industry in France. After a thorough survey, he put in about 100,000 square feet of beds after the French practice. These are narrow, rounded beds of rich loam in pairs and were placed in the cellar of the plant which is carved from solid rock. Thus were approximated the conditions under which mushrooms are grown commercially in the many caves in solid rock near Paris, which became famous during the war as places of refuge during bombardments.

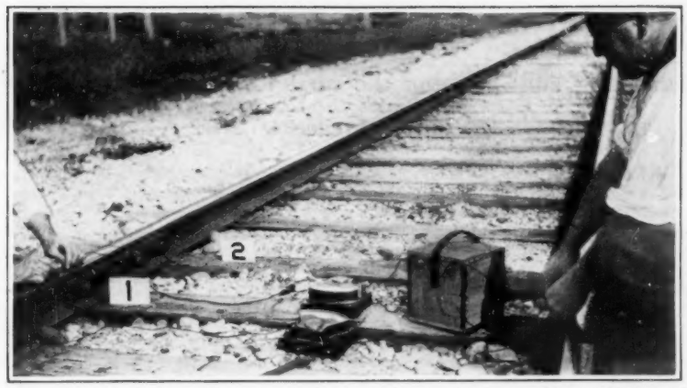
Later a system of flat beds built in tiers was adopted as this allowed a great increase in bed area for the same floor space. Then began a series of remarkable experiments to determine the best production methods.

The first mushrooms were grown from spawn secured through the regular commercial channels, but this was found not to be of uniform quality. Of two beds planted side by side with the same spawn and treated in identical manner, one would ofter bear prolifically while the other would be almost barren.

The production of spawn was then undertaken. In the growing of brewing yeast, a single cell is isolated under the microscope and this is "planted" in a bottle of gelatin. In a few days the cell has multiplied until it appears as a spot of white mold on the gelatin. Then it is transferred to a jar of specially prepared liquor and the mold increases in size until it fills the jar. These "roots" are separated again and again and placed in other jars until, from a single cell invisible to the eye, sufficient yeast has been produced to make a brewing of many thousands of gallons. An exactly parallel process is used in making mushroom spawn. The single "mother" cell is taken from the underneath side of a good specimen of mushroom, chosen from a spot in the beds which bore prolifically. Care is taken to secure a cell which is not contaminated. A number of cells are planted simultaneously and the best of the growths from these are transplanted to the "root" jars. From this small beginning enough spawn is secured to plant all of the beds of the "plantation." The great delicacy of this operation may be judged from the fact that there are in this country only two concerns, aside from this brewery, which have succeeded in producing spawn on a commercial scale.

Noting the rapid growth of mushrooms in the natural state immediately after a thunder storm, experiments were begun to determine the response of culti-

(*Continued on page 318*)



Testing the resistance between rails in order to determine the condition of ties and roadbed and the leakage

Testing Roadbed Conditions by the Resistance Method

By S. R. Winters

THOUSANDS of people who annually frequent railway trains can easily distinguish between a roadbed that unduly jars the speeding train and one that lends itself to the ease and comfort of swift travel. Other citizens, possibly, are not alive to the varying elements which enter into roadbed construction until defective ties are responsible for a train derailment of serious consequences. Not content with casual observations, however, the National Bureau of Standards and the Forest Products Laboratory jointly conducted a series of investigations revealing the conditions of a roadbed which inure to durability of construction of the equipment and safety of speeding trains.

For example, oil is more efficient than straight creosote as an insulator in barring moisture from ties. Likewise, oil has possibilities of minimizing leakage currents and as a preservative of the wood against decay. Ties treated with zinc chloride offered a lower resistance than test specimens bathed in oil and creosote. The test section in which scrubbed ties were used evidenced a slightly higher resistance than the section not thus treated. The resistance of sections in which new and old untreated ties were employed, respectively, were twice that revealed by roadbeds with chemically treated ties and one-half that found for tracks with oil-treated ties.

The resistance measurements of steam railway roadbeds were determined by a series of observations between various test sections from which the resistance to earth of each section was calculated. The isolation method as applicable to street railway tracks proved impractical. No water-piping system was accessible for an earth connection and the track network, not being bonded, could not easily be employed in this rôle. A battery of four dry cells was connected between two remote sections of the test tracks and the current flow and voltage noted. The observation was repeated for various pairs of sections. From the results of a series of measurements it was possible to establish a number of equations, the simultaneous solution of which gave the resistance of each section to earth.

Transplant the base of operations from Madison, Wis., to Washington, D. C., and the conclusions of similar investigations with street railway roadbeds are available. The Bureau of Standards even built sections of experimental roadbeds in order to variegate the facilities offered by local electric railway companies for conducting the tests. The investigations, it would seem, were among the first to emphasize the possibilities of insulating roadbeds or constructing them in such a fashion as to curtail the leakage of electricity from street railway tracks. A portable storage battery connected between four rails of a track and a water hydrant on a large main was included in the measuring equipment. An ammeter and a regulating resistance were included in the circuit, as well as nine Edison storage cells providing a constant

(*Continued on page 318*)

Left: Original method employed in brewery for raising mushrooms, using narrow, rounded beds of rich loam in pairs. *Right:* Later method of raising mushrooms, using tiers of flat beds and increasing the bed area manifold for the same floor space. *Above:* Harvesting the mushrooms for the day's supply to the New York hotels.

How mushrooms are raised in a New York brewery where formerly yeast was grown for beer

Solving the Labor Problem—V

Educating and Training the Man to Fit Him to His Job

By Charles Frederick Carter

HENRY, an office boy, was discharged by the New York Edison Company for using bad language in the presence of women workers. Although only fifteen years old, Henry had already developed symptoms of common sense which he manifested by seeking the office manager a few hours later, expressing contrition for his conduct and asking for reinstatement. He said his father was dead; that his mother took in washing to support the family, which included a little sister; that he had had to leave school because his meager earnings were needed to piece out the family's scanty income; and that he wanted a day job so he could go to night school to fit himself to earn enough to relieve his mother of drudgery. Then he went home and told his mother all that had happened. Next morning she appeared at the office to support Henry's plea. She said if he was given another chance she felt sure he would appreciate it. Henry was taken back.

This incident was the first in a sequence that led to the organization of the National Association of Corporation Training, which, ten years after Henry was discharged, includes in its membership 154 corporations having an aggregate capitalization of six billion dollars and two million employees; and this association is but a single manifestation of a great National movement for training employees—for fitting the man to the job—which Theodore Roosevelt, a short time before his death, pronounced the greatest development of the age. It may not be amiss to add that Governor Miller, of New York, and President Harding have expressed a keen interest in this movement and a determination to do all they can to further it.

To set down events in order, this affair of Henry's brought home to the New York Edison Company for the first time the importance of having in the commercial department where they came in contact with the public only employees who understood and observed at least the ordinary courtesies of life and had at least the equivalent of a grammar school education. The management reasoned that Henry's delinquency was not due to innate depravity but to ignorance; that if experience had demonstrated anything it had shown that Henry was typical of most of the raw material from which junior office help might be recruited; that instead of incurring the inconvenience, annoyance and loss inevitably associated with a perpetual round of hiring and firing it would be much wiser to give the force already in hand such training as might be required to fit it, not merely to hold present jobs, but to qualify it for advancement. Experience with a technical course for employees in mechanical and electrical departments instituted some five years before confirmed this conclusion.

Twenty-eight boys and girls in the commercial department were found to be so poorly educated they could not pass the simplest examination. So in 1911 the company announced that a class for junior employees to be conducted by F. C. Henderschott would be organized to take a course corresponding to that of a grammar school with certain special subjects pertaining to the business. Henry and thirteen others welcomed this opportunity to fit themselves for their life work; the other fourteen resigned rather than have their personal liberty to continue an incompetent, poverty-stricken existence curtailed.

Just to show the sort of material from which the company had to mold its office and selling staff, an examination early in this first course elicited the information that the principal three cities in New York were Buffalo, Philadelphia and Massachusetts; that the principal mountains in the state were the Rockies and the principal valley the Yosemite; and that the Erie Canal was dug to afford more direct route to the East Indies.

At first glance this may seem humorous; but when it is realized that the boys and girls 15 to 18 years old who gave these answers were launched on the world to make their way so fearfully handicapped; and further, that they were fairly representative of the material from which corporations which serve the public must recruit their employees, the matter ceases to be a subject for laughter and becomes tragic.

Under the energetic tutelage of Mr. Henderschott the class made rapid progress. All are now filling responsible positions. Henry is now a general representative of the company at a good salary. His mother is released from the tub and his sister is in high school.

The company was encouraged to make a rule that all employees, in the Commercial Department, regardless of length of service, should take instruction. Six gray haired men past fifty felt they could not aspire to higher positions and so asked to be excused. But after two or three meetings of the class had been held two of the six, both grandfathers, asked to be enrolled. One was a solicitor for signs at $18 a week; now he is in charge of all exhibits of electrical appliances at a much larger salary; the other who was agent in a district office became assistant general manager at headquarters. The four who declined instruction have not advanced.

Mr. Henderschott, the instructor, was making as rapid progress as his pupils. He learned that other corporations were feeling the need for more competent help as keenly as his own; yet, despite this great need only thirteen other corporations were making any attempt to train office help. While a few far-seeing corporations had been making rather desultory experiments in apprenticeship courses to maintain their mechanical departments, and while vocational training was beginning to arouse a good deal of interest, it was making little progress because it was in the hands of academic teachers. Mr. Henderschott took the initiative in forming an association that would coordinate the educational work of all corporations which had undertaken anything of the kind, and that would induce others to take it up. Through bulletins, reports, annual conventions and more frequent meetings of local "chapters" members could have the benefit of each other's experience and thus reduce to a minimum the inevitable mistakes of pioneer work.

NO matter what may be the nature of the work, the employee with a certain amount of education and training is preferable to one without such education and training. Education and training may mean better work, a spirit of cooperation with other workers brought about by a better understanding of the production processes, and certainly a fairer insight as to the relationship between employee, foreman, superintendent, and officials of the organization. With these facts in mind, there was formed some years ago a country-wide organization known as the National Association of Corporation Training, for the purpose of coordinating the educational work of all corporations. Guided by eight years of constructive development the members of this association are making substantial progress toward minimizing waste through lack of proper training, labor turnover and avoidable sickness and accident, and that is precisely the story we have asked Mr. Carter to write for us as another instalment of our Solving the Labor Problem series.—THE EDITOR.

Beginning in 1913 with a membership of 48 corporations the National Association of Corporation Schools rendered such valuable services that it won the interest and support of many of the largest employers in the country, including such representative concerns as the Westinghouse Electric and Manufacturing Company, the General Electric Company, Carnegie Steel Company, American Bridge Company, Illinois Steel Company, Solvay Process Company, Standard Oil Company, of California, National Cash Register Company, H. J. Heinz, W. R. Grace & Co., Yale & Towne, Pennsylvania Railroad Company, Federal Reserve Bank of Chicago and New York, Montgomery, Ward & Co., Metropolitan Life Insurance Company, Travelers' Insurance Company, Pressed Steel Car Company, International Harvester Company, Armour & Co., and others of that type, to the total of 154; as already stated, L. L. Park, Vice-President of the American Locomotive Company, is President and Mr. Henderschott is Treasurer and Managing Director of the organization under its present title of the National Association of Corporation Training.

While other agencies have contributed to the result it is chiefly due to the activities of this association and its individual members that personnel problems are now receiving at the hands of practically all progressive employers in America the same degree of attention as those relating to production, marketing, traffic, accounting and finance. Guided by eight years of constructive development the members of this association are making substantial progress toward minimizing waste through lack of proper training, labor turnover and avoidable sickness and accidents.

Perhaps the key to the activities of the association and their scope may be found in the list of subjects assigned to seventeen subcommittees to study and report upon at the ninth annual convention next June. The list is as follows: Application of psychological tests and rating scales in industry; employment; executive training; foreman training; health education; job analysis; labor turnover; marketing; office work training; profit sharing and allied thrift plans; public education; skilled and semi-skilled labor; technical training; trade apprenticeship; training for foreign commerce; unskilled labor and Americanization; visualized training (*i.e.*, the use of motion pictures for training purposes).

Possibly a still better idea of what the more progressive employers are doing to contribute to the mutual benefit of all concerned in industrial and commercial enterprises, develop the efficiency of the individual employee and coordinate his best interests with those of his employer, may be found in a résumé of the educational activities conducted by the Westinghouse Electric and Manufacturing Company for the benefit of the twenty thousand employees at its East Pittsburgh plant.

First is a trade apprentice course of four years in the more important trades, such as draftsmen, pattern making, foundrymen, machine tool making for mechanical and electrical departments. The apprentices work mostly in material and machine shops. There is a special department for preliminary training. The minimum of class-room training is four hours a week throughout the course. Graduate apprentices and those still serving may enroll in the Casino night technology school under separate management but largely supported by the corporation where they can receive instruction in physics, chemistry, metallurgy, theoretical electricity, applied electricity, power and mechanics, mathematics, engineering and shop problems and applied design. If needed, pupils must take a course in English.

There is also the Westinghouse Club which provides lectures on subjects of general interest and on theory and design. For college graduates who may wish to specialize in works management, sales, or engineering and design, there are special one-year courses. For those who have put in two years at college there is a special two-year apprenticeship. Another special course is for those who plan to go to foreign countries as operatives or salesmen. Finally, there are special daily lectures for executives and members of the clerical staff on the design and use of the products of the company, the technical principles underlying shop practice and the work of the associated plants.

From this schedule, which may be taken as fairly representative of the most advanced practice, it will be seen that no one from the newest office boy to the veteran executive is considered by up-to-date employers to be beyond the need of training. Indeed, it is dawning upon the managements of great enterprises that foremen and higher executives are quite as much in need of training to fit them for their jobs as the workmen. Developments in applied science are swift and continuous; but still more important is the knowledge of the art of handling human beings, in which foremen and other executives are, or should be, versed.

There is a growing recognition of the fact that the good will of employees is as valuable as that of customers, to secure which so much energy, thought and money are devoted. No concern which advertises as its motto that "the customer is always right" has had the temerity to extend that attitude to the adjustment of complaints of workmen; but an increasing number is manifesting a lively solicitude regarding the treatment of employees. When one has invested anywhere from

(*Continued on page 319*)

The New Commissioner of Patents

MR. THOMAS E. ROBERTSON, who has been appointed by President Harding to be Commissioner of Patents, was born in Washington in 1871, where he has been for many years active in the work of the American Patent Law Association, of which he is a former president. The Commissioner, who has been a life-long resident of Washington and Chevy Chase, Maryland, is a man of high personal character, who is held in great regard in the Washington fraternity of patent attorneys.

The appointment of a new Commissioner of Patents is a matter of vital concern in a country which is so prolific in invention as the United States; and the fact that Mr. Robertson not only comes of a family of inventors and lawyers but is himself a well-known patent attorney of long standing will give widespread satisfaction.

The new Commissioner is a graduate of the National University Law School, and he also took a course at Columbian, now George Washington University. In addition to having filled the position of president of the American Patent Law Association, he is a member of the bar of the United States Supreme Court, the District Court of Appeals and the Court of Appeals of Maryland. Mr. Robertson is a member of the University Club and the Washington Board of Trade.

Mr. Robertson's father, Mr. T. J. W. Robertson, who is still living, was interested, prior to 1867, in the production of inventions, having invented many improvements in sewing machines and in engraving machines for cut glass, and a postal canceling stamp. In connection with these inventions he was associated with Mr. Alfred E. Beach, one of the founders of the SCIENTIFIC AMERICAN, and from 1867 to 1876 he was an employee of the Washington office of the firm of Munn & Company, finally leaving the firm to go into business for himself. For some time Mr. Robertson, Sr., was Washington correspondent of the SCIENTIFIC AMERICAN, and throughout his long life has maintained his interest in inventions and patents.

Mr. T. J. W. Robertson's oldest son, Alfred Beach Robertson, who was named after Alfred Ely Beach, and was also a patent attorney, was employed with his father in our Washington office.

Identification of Oak Woods

OVER fifty species of native oaks assume the proportions of trees, and about twenty-five are used for lumber. After the oaks are cut into lumber, there is no means known to the United States Forest Products Laboratory by which they can be identified as to exact species. By examination of the wood alone, however, it is easy to separate the oaks into two groups—the white oaks and the red oaks; and for most purposes, fortunately, it is not necessary to classify them any further. The oaks all average about the same in strength, but those in the white oak group are much more durable under conditions favorable to decay than those in the red oak group.

The white oak group includes true white oak, swamp oak, bur oak, cow oak, post oak, overcup oak, and chestnut oak. The red oak group includes true red oak, yellow or black oak, scarlet oak, Spanish oak, Texan oak, black jack, water oak, willow oak, and laurel oak.

The color of the wood is a ready but not absolutely reliable means of distinguishing the white oaks from the red oaks. Red oaks usually have a distinctly reddish tinge, especially near the knots. The wood of the white oaks is generally a grayish brown; but occasionally a reddish tinge is found in white oak lumber.

For more accurate identification it is necessary to examine the pores of the wood. These will be found as tiny holes on a smoothly cut end surface, the largest being visible to the unaided eye. They are not of uniform size throughout each growth ring, but are considerably larger in the wood formed in the spring, decreasing in size rather abruptly toward the summerwood. The large pores in the springwood of the heartwood and inner sapwood of the white oaks are usually plugged up with a froth-like growth called tyloses, and those of the red oaks are open. This feature, however, is not so reliable for classification as the character of the much smaller pores in the summerwood.

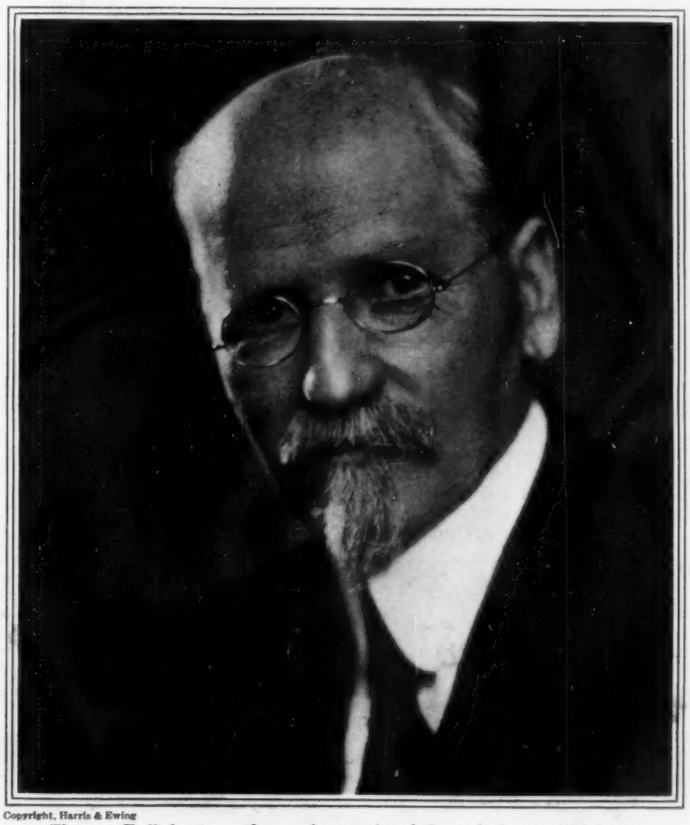
To tell for a certainty whether a piece of oak belongs to the white or red oak group, cut the end grain smoothly with a sharp knife across several growth rings of average width. With the aid of a hand lens examine the small pores in the dense summerwood. If the pores in this part of the growth ring are plainly visible as minute rounded openings, and are not so crowded but that they can readily be counted, the wood belongs to the red oak group. If the pores in the summerwood are very small, somewhat angular, and so numerous that it would be exceedingly difficult to count them, the wood belongs to the white oak group.

Heat-Proof Rust-Proofing

EVERYONE who has ever compared the upper and under surfaces of a steel rail will realize that metal surfaces which are not properly protected from the atmosphere, either by operating contact with other surfaces or by a definite protective coating of some foreign substance, deteriorate rapidly under the rusting influence of the air. A plow on the farm that should last twelve years ordinarily lands in the scrap heap during its third year, through this destructive agent, and this is but one example that might be given out of many.

An especially troublesome phase of this problem is met with in warehouses and stock rooms, where the storage, for considerable periods, of finished metal parts is absolutely necessary. It is customary to coat such parts with a grease of some sort as a protection against the ravages of the atmosphere; but the temperature in storage places of the character mentioned often attains a surprising degree of super-heat as compared with the surrounding free spaces, causing the grease to run and leave the metal exposed.

There was recently demonstrated in New York a new protective coating which is less open to this objection than any we have previously seen. In a very severe test the new substance, placed on a metal block in a rather large daub, not only refused to run at temperatures which reduced all its competitors to the consistency of water, but actually retained its shape at these temperatures, and did not begin to slide until the heat went close to 200 degrees. Yet in spite of this resistance to melting, the product in question was easy to apply in a properly thin coating. The manufacturers of the new protective material are highly confident that it furnishes an absolute insulation against rust, and that it will stay on at any temperature which can be reached outside of an actual conflagration.



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Thomas E. Robertson, the newly appointed Commissioner of Patents

John Burroughs

THAT brave and genial naturalist, one of America's greatest old men, has passed away. John Burroughs had spent the winter in California in the hope of regaining his lost health, but the trip was too much for the octogenarian and he died on a train in Ohio while on the way to his home "Riverby," near Poughkeepsie. At the time of his death his mind was so alert that few could believe that he was to have an eighty-fourth birthday, yet on this birthday he was buried on the mountainside at Roxbury where he was born. From all over the peaks and valleys of the Catskills old neighbors came to pay him final honors, while his chums of later life, Thomas Edison, Henry Ford and Harvey S. Firestone, stood beside the open grave. The simple rites were soon over and the purple haze of dusk descended on the village as the mourners wended their way down the mountain and John Burroughs was alone with the nature he loved so well.

Perhaps the appreciation of Burroughs as a power in the realm of nature can best be summed up in the words of another naturalist of great note, Prof. Henry Fairfield Osborn, who said:

"In the passing of John Burroughs, all who love nature and feel kinship with other nature-lovers, have suffered a great loss. An earnest student of natural history, he never lost the realization that 'Nature is a volume of which God is the author.' His appeal and his value as a teacher of young and old alike make his death an irreparable loss."

John Burroughs, "student of mice and men," began his study as a naturalist in the days when the Western plains were still overrun with buffalo and when species of animals and birds, now approaching extinction, were so numerous that they excited no curiosity except among born naturalists.

As the years rolled on, Burroughs became famous as a naturalist and writer on nature topics, and the paths of persons interested in the study of wild life led to his home, Riverby, overlooking the Hudson, and to his summer study, "Slabsides," a house built by himself out of bark-covered boards, the first cuttings off the log. He became known as a patriarch, and interest increased in his work as he and the late John Muir, naturalist of the Sierras, and Theodore Roosevelt, "naturalist of the White House," made their joint trips in the study of wild life and natural phenomena in various parts of the country.

When Roosevelt was in his controversy with the "nature fakers," Burroughs rushed to his assistance with the assertion that the "White House naturalist" was a real naturalist and was correct in his assertions about animals and birds. He and Roosevelt were mutual admirers, and frequently expressed their appreciation of each other's work as naturalists.

Hearing a Shadow

WE have all heard of the proverbial pin to be heard dropping, and the silence which could be felt, but Mr. Graham Bell made a statement on May 17, 1878, that he could "hear a shadow" (by interrupting the action of light upon selenium).

Professor Willoughby Smith carried out this idea and soon after heard the sound produced by the action of a ray of light upon a bar of selenium in connection with a telephone.

The experiment excited great interest at the time because the telephone and photophone were in their infancy. How was it done? A series of flashes of light were let fall on selenium, causing intervals of light and darkness. The strength of the current continually varied, and, if the flashes succeeded each other quickly enough, and with sufficient regularity, a musical note was heard by a person listening at the telephone. Moreover, by placing a small mirror whereby light may be reflected upon a distant selenium cell, aided by lenses suitably arranged, Professor Graham Bell was able to obtain articulate sounds at about 700 feet.

Selenium was not much known in 1878 when it was discussed at the Royal Society, London. It is a rare element, somewhat resembling sulfur. In its vitrous state it is a bad conductor of electricity, but in its crystalline state, it is a very good one and when exposed to light the electric resistance is a great deal diminished.

Preventing the Roll of Ships

Past and Present Schemes for Stabilizing Ships and Why the Gyroscopic Stabilizer Is Practical

By J. F. Springer

FOR many years there have been serious attempts to develop some reliable method of preventing the roll of ships at sea. Naval people especially have been interested, as the roll disturbs the effectiveness of gunfire. As far back as a couple of score years ago, the British and also the Germans sought to utilize great tanks of sea water in an effort to control rolling. In fact, as E. A. Sperry tells us, such tanks were actually installed on two war vessels. Later on the Americans tried out the action of tanks, one ship having had installed upon her no less than three such devices.

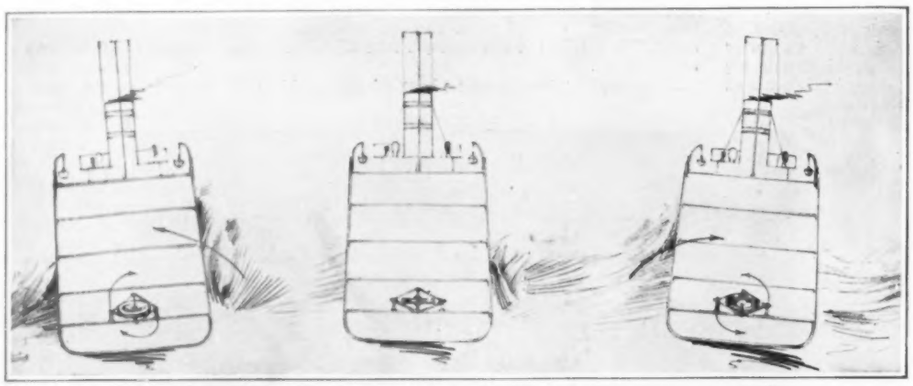
The difficulty encountered by the foregoing-mentioned method of controlling the roll seems to center on the fact that there are three periodic movements of heavy bodies. The ship rolls in a period natural to herself; the waves have a periodic motion; and the water in the tank has a period of its own. To bring unison out of the three seems to have proved practically impossible. Besides, the size and weight of a loaded tank makes a considerable reduction in the net carrying power of the vessel.

The British made another important attempt to control the roll. This was in the time of Sir John Thornycroft. He made use of a big horizontal pendulum. It was located down in the hold and was operated by hydraulic means. It seems that development was halted by the realization that the relative weight necessary for the pendulum was really prohibitive. The Germans tried the tank method and also one dependent upon what may be called the passive gyrostat. Without going into details, suffice it to say that all these efforts to produce a stabilizer of reasonable weight and capable of satisfactorily controlling the ship have failed of general adoption either in the Navy or the Merchant Marine.

It has remained for America to grasp the essential idea. A weight having a slow motion—such as the water in a tank or the heavy pendulum—could not develop an adequate moment because of the limitations on the weights it was permissible to allow. By giving swift motion to a weight, however, the power of control is greatly increased. This is what is done in the active gyro-stabilizer which has already been tried out. A notable installation is the one on the U.S.S. "Henderson," an army transport ship built at the Philadelphia Navy Yard. This vessel has been in operation with a displacement as large as 11,500 tons. We are assured that the guaranteed stabilizing moments have been easily developed.

The present device seeks not so much the reduction in the roll of the ship as the prevention of all roll. The results are secured by applying artificial precession. The rotating mass of the rotor represents great latent energy and derives its importance largely from the enormous velocities with which moderate weights may be moved. As the inventor says: "A comparatively few pounds are actually capable of doing the work of tons. With the active gyro, this is all held in phase, and is available for the important purpose of holding the ship free from even the beginning of roll."

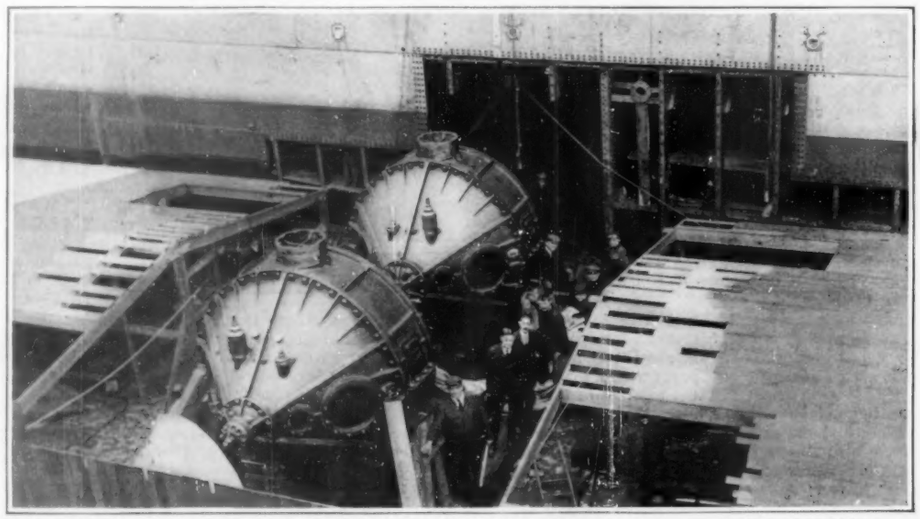
An important matter relates to the increases in size and cost as larger and larger ships are equipped with the proper plant. The stabilizing power varies as the 5th power of the linear dimensions. This means that a gyroscope, capable of 32 times the power of a given one, would nevertheless have to have linear dimensions only twice those of the less powerful machine. The reason for this is that 32 is the 5th power of 2. However, the weight and cost go up at a good rate but at one much less than the 5th power of the linear dimensions. Naturally the weight increases as the cube; so that for the gyroscope of double dimensions the weight would be multiplied by the cube of 2—that is by 8. The cost goes along with the weight. We have then the result that a gyroscope having 32 times the stabilizing power of another will weigh only 8 times as much and cost only 8 times as much. The big ship thus has a great relative advantage over the smaller one, as its gyroscope equipment will not weigh anything like what the size of the ship would indicate, nor will it cost anything like the relative amount. The problem and the cost reduce, relatively, as the size of the ship increases.



The action of the modern ship stabilizer, showing how the gyroscope neutralizes the effect of each wave

The manner of stabilizing is a matter of interest. The ship is not held as in a great vise, with the waves free to beat against it. The ship goes with the waves much as a western America rider goes with his horse. There is, practically, no contest between wave and ship. The result of an experience based on a large number of installations in actual service is said to be to the effect that a ship freely riding the waves with its mast held vertical by the relatively small gyroscope installation, has to undergo less than 1/6 to ¼ of the strains imposed when put under precisely the same conditions apart from the gyroscope. So, then, instead of the gyroscope adding to the stress and strain, it minimizes them. The slow precessional movements of the rapidly rotating gyroscope may be instantly started up or stopped, at the will of the operator. This gives opportunity to note the behavior of the ship with and without gyroscopic stabilizing, but with all other conditions the same. Among the changes produced is the cessation of creaks and groans of the ship working along in bad weather. These may be very noticeable with the ship under ordinary control. When the stabilizer is put into action, it is understood that these instantly cease. This means, no doubt, that the racking of the vessel has also come to an end. It appears that the eminent British naval architect, Sir William White, has indorsed this view. He stated that, from the point of view of the naval architect, the strains introduced by the use of the gyroscopic stabilizer for the purpose of holding the ship in a free riding position were negligible. He thought that the strains and stresses were only a small fraction of those otherwise set up by a ship actually rolling in a storm.

In fact, Sir William gave it as his opinion, at a time when apparently there had as yet been no actual test in a rough sea, that the vessel stabilized by the gyroscope would not ship seas but would upon stabilization commence to be dry and would subsequently stay dry. This in itself is a very large matter, quite apart from the remaining advantages of the prevention of rolling. What Sir William then thought has since been found to be true. It will perhaps be gathered from the foregoing that the use of the gyroscope prolongs the life of the ship and eliminates the hazards incident to seas washing over the decks. The advantage to a passenger ship in respect to the comfort and safety of the passenger is rather obvious. But there are still other advantages, not so obvious. When a ship rolls, there is a displacement of water in the direction perpendicular to her length. This arises from the fact that the wetted surface is not molded to the form of a cylinder. These displacements of water involve the expenditure of power for the reason that the vessel is continually being shoved ahead by her propellers. In short, because of the non-circular outline of a cross-section of the wetted portion, the ship's power plant expends a part of its energy in overcoming the extra resistance. What really happens is, naturally, a reduction in forward speed. This means a money loss. It has been estimated that the power loss to a ship of 37,000 tons running at 22 knots might very well amount to 3,100 horsepower.



Installing the gyroscopic stabilizer on the U. S. S. "Henderson", an Army transport ship of 11,500 tons

There is another economic advantage that affects the cost of operation. When a ship is permitted to roll, the course cannot be rigidly held. The ship requires "helm"; and this requirement, even when slight, necessarily involves a slowing down of the vessel. Further, as the rolling ship does not maintain a straight course but pursues a sinuous one, the effect is to reduce the actual speed on the desired course. Not only is there a lengthening of the path, but there results a "bad angle of attack." This means further loss of speed, an extra consumption of power—that is, a money expense.

(Continued on page 319)

Left: Crucible in position, ready to pour thermit steel into the mold. *Center:* Acute angle thermit-welded crossing for double-track street railway and single-track steam railroad intersection. *Right:* Yellow pattern wax applied to the frog and molded to the desired weld. A mold is then constructed around the wax model which is then burned out to form a mold for the metal.

Two steps in the welding of steam railroad track crossings and an example of the intricate trackwork made by this method

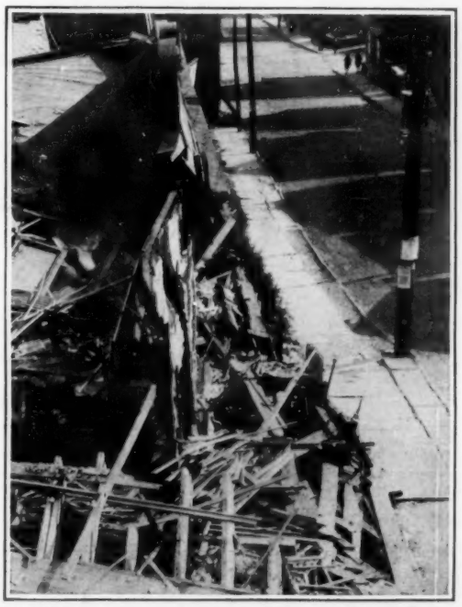
Constructing Steam Railroad Track Crossings by Means of Welding

THE first steam railroad track crossings ever constructed by welding rail arms into frogs have recently been placed in service in St. Joseph, Mo., at certain intersections of the street railway track with the steam railroad lines. As this special work is the first of its kind to be installed in steam railroad track, it will be interesting to observe how this form which has proved so successful for street railway track will stand the exceedingly heavy traffic of steam roads.

The frog was made from street railway girder rails, but the general method of welding the steam railroad tee rail frogs is the same. The ends of the rail pieces which form the frog are cut to the desired shape with an oxy-acetylene torch. They are then lined up together and clamped on a layout bed, leaving a slight opening at the frog for the insertion of yellow pattern wax which is molded to the shape of the desired weld. The mold is then constructed around the wax pattern and wooden riser and pouring gate patterns inserted to allow space for the pouring of the weld. These wooden patterns are later removed and the wax burned out of the mold by means of a preheating torch, which also serves to heat the rail ends forming the frog to a good red heat, suitable for welding.

A charge of thermit, which is a mixture of iron oxide and aluminum, deposited in a crucible suspended over the mold, is then ignited. A chemical reaction takes place, during which the aluminum combines with the oxygen of the iron oxide to form aluminum-oxide (or slag) in a highly super-heated molten state, while the iron is set free and is produced as liquid steel at approximately 5,000 degrees Fahrenheit. This liquid steel is then tapped through the bottom of the crucible into the mold and amalgamates with the rail sections to be welded, so that finally the entire mass will cool down to form a single homogeneous section.

Track welded special work can be made at the nearest place where a supply of compressed air is available and the completed layout then transported to the crossing and quickly set into position with a minimum delay to traffic. In the case of double track crossings, two halves of the crossing can be constructed in the shops and the projecting arms of each half later welded together at the crossing. The advantage of the welded crossing, with no tie plates, bolts or other accessories, are obvious. In fact, it combines the numerous elements into a single strong, uniform, jointless track work.



Looking down a street in Scranton, showing a row of collapsed houses due to undermining

The Undermined City of Scranton and Its Underground Fires

FOR years the residents of Scranton, in the heart of the Pennsylvania coal fields, have had the rather unpleasant sensation of momentarily expecting their houses to fall from under them. Likewise with their land and their streets and their places of business, for a good part of the city of Scranton covers former and present mine galleries which cave in at times, and thus take away the support of whatever happens to be but a short distance overhead.

The accompanying views tell better than words what a menace certain residents of Scranton have been facing of late. Here we have residences and business buildings toppled over and collapsed by the settling of the ground on which they have been built. Fortunately, this has occurred in but one section of the city, but nevertheless the damages and losses have been severe.

Quite recently the residents of lower West Scranton have been living over a raging furnace, while mine officials and city authorities have been exerting every effort to determine the exact location of the subterranean fire. It appears that a fire has been raging for years in what is known as the Contineutal mine. But the recent fire is apparently another fire, and it is now believed that there have been two mammoth mine fires instead of one and that the flames have been spreading over an underground area of approximately 50 acres. While there has been no immediate danger to the thousands residing over this particular area, officials feared that if any surface settlings should occur while the blaze was raging the fumes of gas, sulfur and black damp would seep through the crevices and possibly enter the homes of the residents, proving fatal in such cases.

At any rate, it is not the most pleasant sensation in the world to be living or doing business right over a coal mine.

Realizing all this, the municipality of Scranton has appropriated a large sum of money and taken steps to put an end to the menace of such long standing.

Photo by Jack Dempsey Copyright, Keystone View Co.

What the settling of the ground due to the undermining of a section of Scranton has meant to property owners, and a collapse of a street and the bursting of a water main due to mining operations

Finding Jobs for Radium

Facts and Figures Regarding the Many Uses to Which This Most Precious of Metals Is Put

By Harry A. Mount

THE visit to this country of Mme. Curie, the French scientist who first isolated and named radium, and the presentation to her of a gram of the precious element, directs attention to the fact that the United States has become within the brief space of a few years the world's producer of radium. Indeed, of an anticipated world production of 25 grams of radium in 1921, practically all will come from this country.

Twenty-five grams of radium sounds quite little when compared with the world production of any other precious metal. But when it is reflected that there exists in the whole world only about five ounces of extracted radium, the production of nearly an ounce a year is large. But what will become of this ounce of radium?

This is a pertinent question, for recently it has been proposed that the use of radium be restricted by legislative action to medicinal uses. The action is inspired, no doubt, by the fear that so much radium will be used in the production of luminous material for the faces of watches and clocks and similar uses that humanity will be deprived of the medicinal benefits that would otherwise come from this radium. Another fear is that the visible supply of the ores which now furnish the radium of commerce will be exhausted and that the annual production will be greatly curtailed.

The second objection is most easily disposed of. When at the outbreak of the World War the importation of radium from Europe was cut off and mines were opened in Colorado and Utah, it was seriously proposed to limit the use of radium to medicine when experts predicted that not more than 100 grams of radium could be taken from the carnotite deposits there. But more than that amount has already been taken out and the visible supply is greater than ever before. New deposits are being constantly discovered and within the past month prospectors have announced additional deposits estimated to contain 90 grams of radium.

There has been a great deal of speculation among mining engineers, commercial users of radium, Government authorities and others as to whether the supply of radium would be continuous. The present fields in Colorado contain the only radium ores in the world which are being worked commercially.

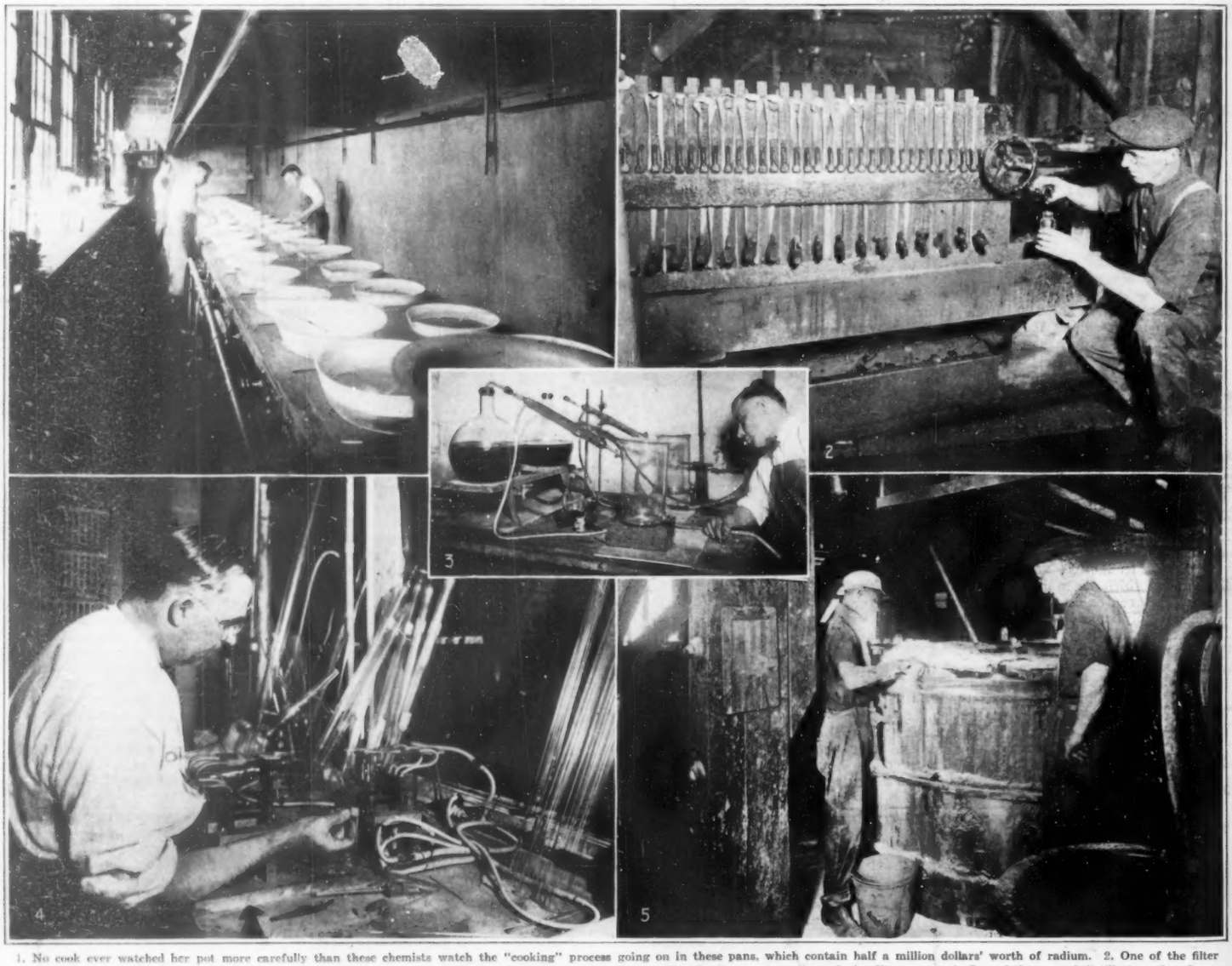
Before the war this country went to Europe for its radium. This was obtained from pitch blende which came from the lead and silver mines of St. Joachimstahl, Bohemia. While pitch blende contains from 30 to 70 per cent uranium oxide, from which the radium is extracted, it always occurs in small pockets in widely separated localities so that it is merely a by-product of other mining operations and no steady supply can be assured.

It is natural that pitch blende should have been the first source of radium as it was the power of a piece of this material to affect a photographic plate that first led the French scientist, Becquerel, and later others, to believe there was present some substance capable of emitting powerful and penetrating rays. To Mme. Curie, a Polish scientist, and to her French husband have gone the credit for isolating this substance.

The ore from which radium is now extracted is known as carnotite and occurs in relative abundance in Colorado and Utah where it follows generally an enormous geological fault which runs through this part of the country. The ore contains but from 1½ to 4 per cent uranium oxide, but once located, can be mined by ordinary shallow mining process.

The largest deposits so far discovered are in Paradox

(*Continued on page 320*)



1. No cook ever watched her pot more carefully than these chemists watch the "cooking" process going on in these pans, which contain half a million dollars' worth of radium. 2. One of the filter presses employed in the extraction of radium from carnotite ore. The solids are deposited in thick layers while the liquor passes through the filter press. 3. One of the several distillations that figure in the gradual elimination of all other elements save radium. 4. The radium reduction plant has its expert glass-blower, who makes the special apparatus required. 5. Vat containing vanadium, one of the principal by-products precipitated by chemical action

Some phases of the intricate process of reducing carnotite ore in order to obtain radium

Speeding Up the Unloading of Cars

IN any discussion of transportation problems the subject of loading and unloading always looms up big. In fact, more time and money are generally spent in loading and unloading the carriers than in the actual journey, through lack of proper facilities at the terminals.

Typical of the equipment which is now being installed by railroads with a view to speeding up the loading and unloading of their cars is the crane shown in the accompanying view. The crane travels on a pair of parallel rails laid along the wharf. On the transverse members of the crane are mounted two cars which carry their own control cages and hoists. These cars, traveling on independent overhead rails, can be operated quite independently of each other for the entire sweep of the transverse members. In this manner heavy loads, such as boilers, structural steel, large cases and crates, can be lifted off the cars on the barge alongside the wharf and placed on the motor truck, as shown in our illustration.

The crane is operated by electricity, the current being supplied by two overhead wires which are tapped by the two trolley poles which may be seen on top of the crane.

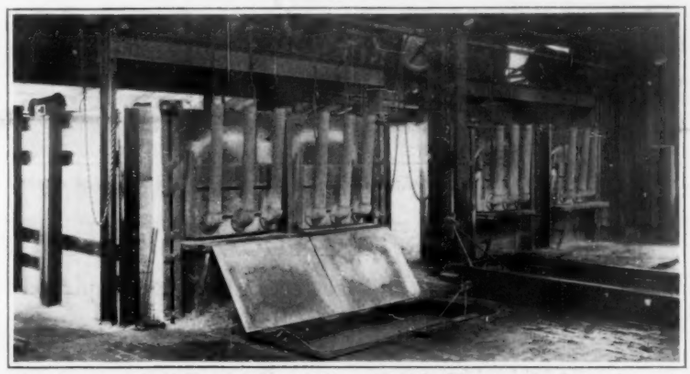
An electric crane with two hoists which speeds up the loading and unloading of freight cars

Steel Heat-Treating Furnaces with Flues in the Doors

THE heat treatment of steel has grown to astounding proportions, so much so that it is an industry by itself. A splendid example of this is shown by the accompanying illustration which portrays the heat treating furnaces in a large American steel automobile-axle plant. A distinctive feature of these furnaces is that they have flues in the doors at the front to provide sufficient draft to bring the hot gases up to the doors and prevent cold spots in front of the doors. These flues, three in number, in each door, are 4½ inches outside diameter in the large furnaces and 3½ inches outside diameter in the smaller and extend up a distance of about 30 inches from about 2 inches above the furnace floor. In some of the furnaces the flues are built in the doors and others have a flue pipe in front of the door connecting with an elbow that extends through a hole near the bottom of the door. The flues can be equipped with dampers if desired.

Waste gas passes to the back of the furnace and around a coil through which the incoming air is delivered by the blower. This coil provides a preheating chamber for the blast. Back of the furnaces, which are arranged in a straight row at one side of the building in line with the interior building columns, is a concrete trench 4½ feet deep in which is located the oil lines and valve connections to the furnace.

The quenching tanks are located with their tops on the floor level directly in front of the furnaces. These have steel plate covers. In the case of the furnaces with hearths raised above the floor the covers are drawn over and rest at an angle against the front of the furnace, forming an incline on which work drawn from the chambers slides into a quenching tank.



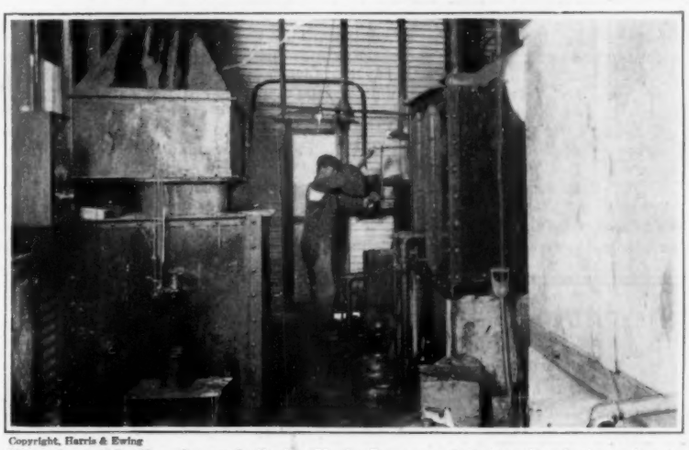
Furnaces for the heat treatment of steel, with flues on the front doors to bring the hot gases up to the doors and prevent cold spots

Petroleum Products for Road Construction

A COMPLETE oil refinery, an experimental equipment for studying methods of treatment and characteristics of typical crude petroleum used in highway construction and maintenance, has been built by the United States Bureau of Public Roads at the Government experiment farm, Arlington, Va. A 70-gallon still, small steam boiler, super-steam heater, blowing kettle, condensing coils, air compressors, and a fuel oil heating system are the units which comprise Uncle Sam's refinery. Steam distillation is the method employed in determining the relative roadbuilding values of petroleums unearthed from the fields of California, Texas, and Mexico.

As fresh contribution to the study of bituminous materials, the preliminary tests as conducted in this experimental refinery have value in the application of results to highway construction and maintenance. The volume of petroleum asphalts, including road oils and flux, used for road-building purposes is of increasing expansion, the latest statistics indicating an annual consumption of 527,775 short tons of domestic petroleum and 650,244 short tons of Mexican petroleum, representing a total value of $17,759,224. Since coming into prominence in 1912, the petroleum obtained from Mexican fields has gained increasing favor as a product employed in building highways, while the use of domestic petroleum has decreased in consumption for this specific purpose in recent years. Hence, the significance of including the three types, gushing from wells in California, Texas, and Mexico, in the original investigations as undertaken at the Arlington Government farm.

Greater density of Mexican asphalts was proven by the tests. Asphalts up to 200 penetration produced from Mexican petroleum showed a specific gravity of 0.02 to 0.03 higher than that of California products. The difference is considered greater than is apparent in the figures inasmuch as a California asphalt of the same melting point is much harder at normal temperature than the output of Mexican oil fields. Steam was passed through the still at a rate calculated to maintain a constant ratio of water to oil distillate in the flow from the condenser.



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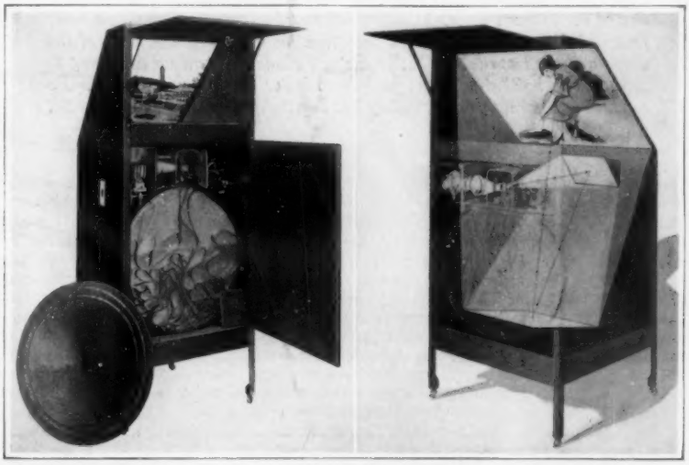
Experimental oil refinery built by U. S. Bureau of Public Roads in order to study petroleums

Motion Pictures Anywhere Without Operator or Screen

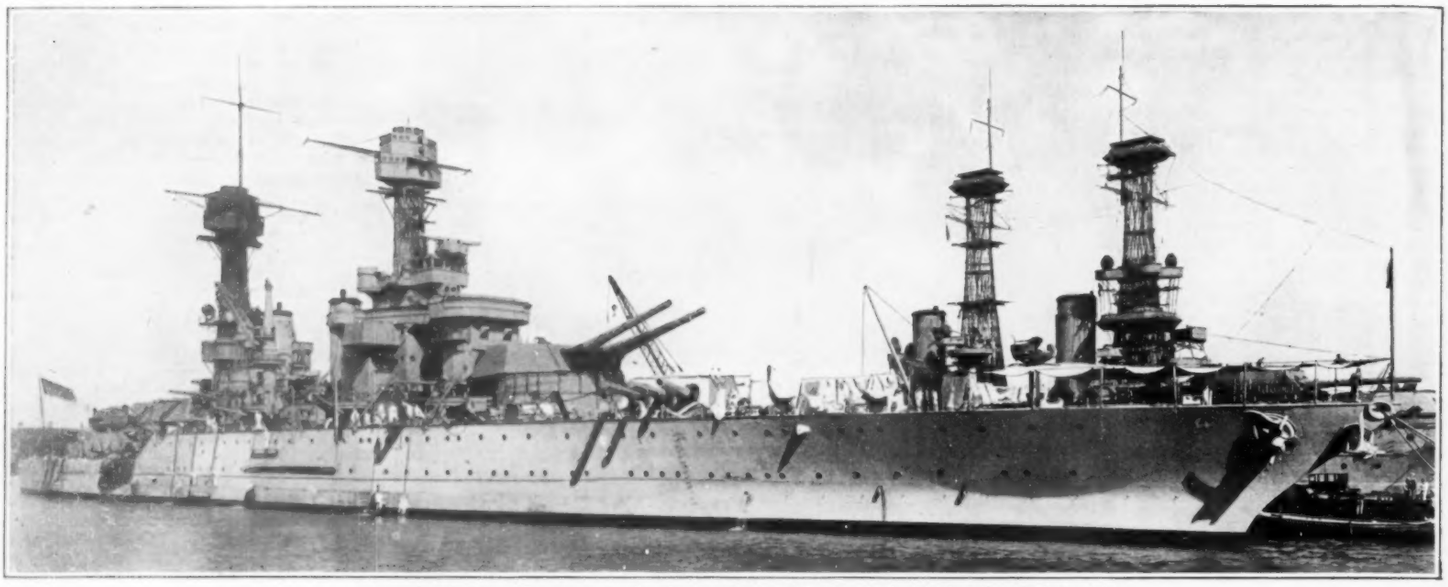
A MACHINE that transforms the motion picture into a simple and practical medium of expression for advertising, demonstration and education has been developed during late years to a state of real practicability. In brief, such a machine is automatic; it does not need an operator; it shows a continuous picture; it can be used in a lighted room.

The mechanism of the machine in question is quite simple. The film is placed in position, a button is pressed, and the projection begins and continues until the current is turned off. The mechanism is enclosed in a steel cabinet, the upper portion of which forms a shadow-box. Back in this shadow-box is a screen, and on this screen is shown a motion picture about two feet square. Should a larger picture on a wall or screen be desired, it is merely necessary to open a door at the rear of the cabinet and project through this opening. It will be noted in the phantom view of the machine that a prism is included in the optical system so as to bend the rays at right angles from the lamp house.

The motion picture apparatus proper consists of an incandescent lamp, continuous and intermittent movements, revolving shutter and lens system. A small motor furnishes the driving power. The film is made in the form of a continuous belt by cementing its two ends together, and as much as 300 feet can be handled. The film is contained in a large circular magazine with the exception of a small loop passing through the projection apparatus. This arrangement permits of the continuous projection of the film without attention. A safety switch cuts off the electric current and stops the machine in case the film should break. The steel cabinet acts as a fire-proof booth, although this is not necessary when the "Safety Standard" or non-inflammable, non-explosive type of film is employed in contradistinction with the usual celluloid film such as is employed in the fire-proof booth of motion picture theaters.



Interior view of the advertising motion picture projector and a phantom view of how it works



Our latest battleship "Tennessee"; the first to be specifically designed for the electric drive

The Battleship and the Junk Heap

Is the Battleship Still the Backbone of the Fleet Or Is It Being Replaced by Other Craft?

By Lyne O. Battle

OUR British cousins are between the devil and the deep blue sea over the question of scrapping their great battleships and preparing for future wars in the air or under the sea. Its lines of communication are so vital to the British Empire that the discussion of the merits and demerits of the battleship have naturally aroused much interest in England.

The heat of the discussion has been felt in America. Our Navy Department has become so much interested that high ranking naval officers have been called upon to testify before the Naval Committees of Congress, and the Naval General Board have made a report on the subject.

The meat of the argument seems to be this: Friends of the all-big-gun-ship maintain that it is still the backbone of the fleet, and that, while the battle line needs numerous auxiliaries to protect it—such as battle-cruisers, light cruisers, destroyers and aircraft—the gun is still the principal weapon in sea warfare. The enemies of the big ship claim that the battleship is doomed—that with the same amount of money spent on submarines, torpedo-planes and bombers, the inordinately expensive dreadnaught will be driven from the seas.

In the discussion on the other side of the Atlantic all hands, including even the opponents of the battleship, are agreed that the capital ships of the grand fleet, notwithstanding the fact that they were many miles from Dover Straits, made possible an uninterrupted line of men and supplies to war-stricken France, in default of which there is no doubt that Germany would have won the war.

Ordinarily the armed forces of progressive powers profit by the lessons learned in past wars, and the main lessons from the Great World War seem to indicate plainly the gun as still the controlling factor as far as capital ships are concerned.

Thus, British capital ships destroyed, or badly damaged during the war were as follows:

(1)	By gunfire in fleet action	3
(2)	By torpedoes in fleet action	1
(3)	By mine	5
(4)	By submarines	5
(5)	By internal explosion	2
(6)	By torpedoes or bombs from aircraft	0

Now of the five ships that were victims of mines, two were lost at the Dardanelles where they were sent over the protest of the ranking naval officer at the British Admiralty, who knew it was contrary to a well-recognized principle of naval warfare that ships cannot be used against shore fortifications, nor can they be used in confined spaces where mine-laying submarines have an opportunity to "lay their eggs." The other three were lost early in the war, before the paravane was perfected. If, therefore, the lessons of the last war are taken to heart, the mine should play a smaller part against the big ships in the future.

Of the five capital ships sunk by submarines two were at the Dardanelles, confined, in a sense, to a small area, thus offering the slow submerged craft an opportunity to attack them. The other three battleships were torpedoed near Malta, in the English Channel, and near Gibraltar, respectively; it is not known whether they were screened by anti-submarine craft when torpedoed, but it is known that *no* capital ships, cruising in fleet with a proper fleet screen, were lost.

No remarks need be made concerning the two ships lost by internal explosion—the answer to that is a more stable, more carefully made powder.

Taking out the five battleships lost by mines, the five lost by submarines, and the two by internal explosion, on the ground that a more expert knowledge of naval warfare should prevent these losses in the future, it can be easily seen that the war lessons point to the gun as the main factor of sea power.

In any study of the question as to whether the big-gun ship is obsolete, attack on it from three planes must be considered: *i.e.*, surface attack, underwater attack and attack from the air.

1. *Surface Attack.*—Students of naval affairs will remember that with the advent of the modern torpedo boat in the nineties, the disappearance of the battleship was predicted. Progress answered, however, with the destroyer to drive off the torpedo-boat, and this was followed in turn by the fast cruiser to take care of the destroyer, and by the battle-cruiser to protect the van and rear of the battle line from the cruiser. The normal fleet then settled down to battleships, battle-cruisers, light cruisers and destroyers, and the fleet that could throw the most metal and hit with it, was the one that could win.

2. *Underwater Attack.*—Next came the submarine which some prophets say will play the main rôle in control of the sea in the future. Now, looking again to the lessons learned in the war, not one capital ship in a properly screened fleet was damaged by a torpedo from a submarine during the whole course of the war. One attack was made on the British Fleet by Wedigen, universally admitted to be the best man the Germans had at the time, but the submarine was rammed and sunk and the capital ships suffered no damage.

The submarine is merely a weapon of opportunity. If it happens to be ahead of a fleet, on its track, and is commanded by an iron-nerved skipper like Wedigen, then it may come within range and take its toll. If the sub is off the track of the fleet, however, its slow submerged speed, while running silently, will not permit it to gain attacking position. If the submarine speeds up, the listening devices in the fleet screen will hear and warn the fleet, and all that the big ships need to do is to avoid that locality. Meanwhile the probabilities are that the fleet screen will get the submarine.

3. *Attack from the Air.*—The other plane from which the dreadnaught is to be destroyed is above water. Here the form of attack is to be by torpedoes or bombs launched from airplanes. This was never tried in the World War. It is reported that, recently, in England, a torpedo attack from airplane was made on a squadron of battleships. Five out of eight of the ships were hit with collapsible-head torpedoes. The fleet was at anchor and there was no battleship screen of destroyers firing at the planes which launched the torpedoes. The fleet was not underway so that individual ships would have a chance, by a touch of the helm, to avoid the torpedoes seen in the water, as was done at Jutland.

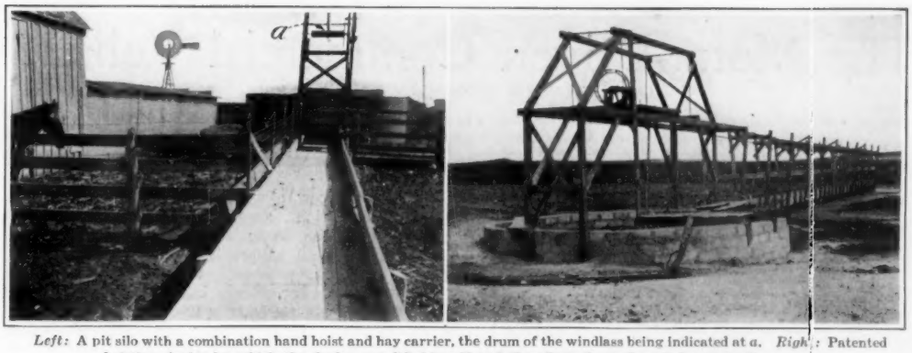
We must bear in mind that in an airplane attack on a fleet with torpedoes, there are several difficult conditions to be met: (1) The plane must be only a

(*Continued on page 320*)

THE discussion which is raging over the question as to whether the battleship is "doomed" or not makes one think of the problem of the immovable post and the irresistible body. The trouble with the disputants is that each of them is given to exaggeration—overstatement of the arguments for his particular side of the controversy. The battleship is not doomed. It is still the backbone of the fleet. On the other hand, war beneath the water and in the air is coming along by leaps and bounds. Of this there can be no doubt whatever. The battleship has been the foundation of the fleet from time immemorial. It is the foundation of our modern fleets. Wisdom dictates that we should hold on to it; foresight demands that we shall recognize the increasing efficiency of the bomb and the torpedo. Whether the new modes of warfare are going to relegate the battleship to the junk heap is for the future to decide. To say that this has happened already is to beg the question.—THE EDITOR.

Why Not the Pit Silo?

WHERE climatic conditions, such as prevail in the Great Plains region, exercise a deteriorating influence on silos constructed of wood and the remoteness of farms renders almost prohibitive the transportation of material entering into the erection of masonry silos, subterranean containers for preserving ensilage are gaining favor. Pit silos are adaptable to the Panhandle of Texas, where the factors above-mentioned operate, superinduced by the cheapness of construction of underground storage-houses for the preservation of large quantities of cattle food.



Left: A pit silo with a combination hand hoist and hay carrier, the drum of the windlass being indicated at *a*. *Right:* Patented hoisting device by which the feeder can lift himself and the silage from the pit by an endless rope

Two underground or pit silos and the machinery for handling their contents

While a pit silo is a "hole in the ground," it is something more if it meets the requirements of retaining the freshness of silage for stock during the winter months. As to soil, the usual specifications are: Firm land, well-drained, comparatively dry, and free from rocks and sand strata. Preliminary borings will determine the character of the soil, and the depth of the silo is gaged by the number of animals to be fed, the containers rarely exceeding 36 feet. A pit silo having an inside diameter of 15 feet is computed to be sufficient to winter 29 head of cattle, allowing 40 pounds to the head, or for 39 animals, allowing 30 pounds to the head.

The trench for the curb of the silo is marked off with a marker, the trench being 2 feet deep within these two outlined circles. The trench is 6 to 8 inches across the top. The inside wall is perpendicular and smooth, and the bottom level. The concrete put into the trench forms the curbing at the top of the silo. This curb of concrete will serve as a foundation upon which a light wall and a cover may be built. After the trench is completed it is filled with water, permitting the moisture to soak into the soil. The concrete is then placed, its composition being one part cement, two parts sand, four parts gravel, and the necessary quantity of water. Once the concrete constituting the curb has settled—three days having elapsed—the digging of the pit is begun.

The soil is displaced, the digging being straight down from the inside of the curb. It is imperative that the wall be perpendicular and smooth; otherwise (should the wall extend outward) a free air space conspires to spoil some of the silage. A plumb line is usually employed in keeping the wall plumb and smooth. If a carrier or track conveying silage away from the silo is a part of the equipment, it is built before the pit is dug and is used in conveying soil when excavating the ensilage container. When five or six feet have been excavated the wall is plastered one inch thick with a mortar composed of one part cement and two parts clean sand. Two coats are essential, two hours intervening between the application of the first

(*Continued on page 320*)

Left: Yellow pine stump in Walton County, Florida, available for distillation. *Right:* Wood distillation plant, steam process, connected with a sawmill for the conservation of sawdust

Converting stumps into turpentine, rosin and other valuable products

Distilling Pine Stumps

DISTILLATION plants located in North Carolina and Florida are converting pine stumps, discarded tree branches, chips and shavings into useful products. A study of the chemistry of yellow pine stumps indicates their possibility of conversion into as many as 26 different products—turpentine, charcoal, rosin, wood for pine oil, etc.

The stumps are transformed into salable articles both by dry and steam distillation of the popularly described "fat" or "light" wood. One company, recognizing the possibilities of utilizing stumps, is signing contracts for clearing the land. The cut-over areas in the South, expanding into millions of acres, are dotted with stumps. These are space-consuming as well as a hindrance to a widespread use of improved agricultural machinery.

By converting the material into turpentine, rosin and other valuable products the expense of clearing the waste acres is considerably minimized. The stumps are cumbersome and heavy, having tap roots which penetrate deep into the soil. The cost of removal is considerable. Heretofore they have been a waste, even when uprooted as a whole.

A new process in distilling yellow pine products is being tried. One of the large automobile concerns is observing the developments with a view to utilization of stumps on cut-over lands.

Turning the Idle Automobile Into a Farm Tractor

THERE is nothing decidedly new in the idea of having the automobile serve as a farm tractor in its spare moments; but the fact remains that heretofore many of the attempts to this end have left much to be desired. Many such schemes have taken the form of a pair of heavy tractor wheels mounted on the rear of the automobile and driven through gears or chain transmission. The latest scheme in this field makes use of a special carriage or chassis on which the automobile is mounted. The rear wheels of the automobile are provided with sprockets which, operating in conjunction with chains, drive the large rear wheels of the carriage or chassis through reduction gearing. The wheels of the automobile serve as flywheels with this arrangement.

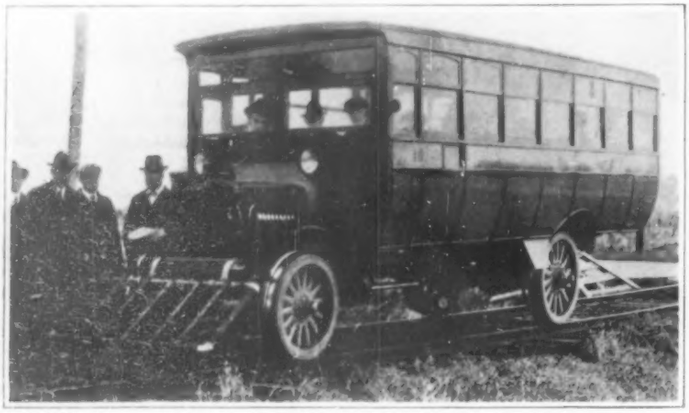
As will be noted in the accompanying illustrations and our cover picture, the car is run up on the carriage or chassis and held in place. The entire operation of placing the automobile and attaching the chains requires about five minutes. The tractor thus formed is steered by means of a vertical wheel on one side. A fan in front of the carriage or chassis supplies additional cooling capacity for the automobile radiator. The tractor by reason of its length and tread negotiates the hilliest, roughest ground with ease, according to the designers. In fact, so far as the service rendered is concerned, the machine is no make-shift;

Automobile mounted on special tractor chassis and ready to do service as an efficient farm tractor as shown in the second view

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Another instance of how a well converted motor-truck may be used for railway service, particularly on branch lines

Motor Trucks May Change Traffic on Short Line Railroads

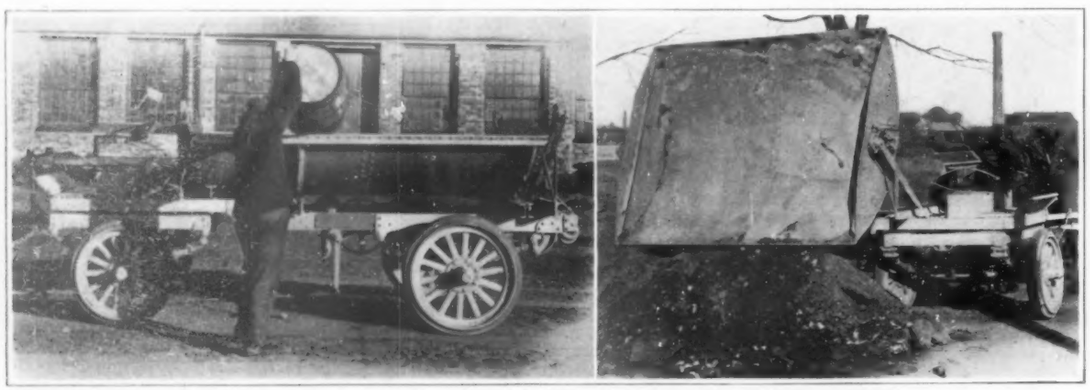
THE Winchester and Western Railroad has recently installed a passenger service which is unique, and it is predicted by competent persons that it may revolutionize the passenger service on short line railroads. This railroad is now operating from Winchester, Va., to Wardensville, W. Va. The car is a powerful gasoline motor truck. It is equipped with a commodious body which seats thirty-four passengers comfortably, is well heated and electrically lighted. This body is mounted on a 2½-ton motor truck, manufactured by a motor truck company of Wabash, Indiana. The wheels are the same as on regular trucks, but instead of rubber tires, flanged iron tires are used, which are the same as those used for the pony wheels of the largest locomotives. The rims are about one inch thick.

The truck runs on schedule time, and is hauling almost capacity loads. It arrives at Winchester at 9:55 A. M. and leaves at 3 P. M. Passengers are most enthusiastic over the new car, and prefer it to a regular passenger coach; there is no smoke, no dust, no cinders, and but very little noise. The Winchester and Western Railroad has already announced a "theater special" run for the truck every Wednesday and Saturday evening, and the car will be available for special trips to town on any special occasion which may warrant it.

New Double Dump Body

DURING the period of business depression now happily drawing to a close the engineers of a trailer manufacturing company have perfected and are now putting on the market a new two-way side dump body constructed according to a combination of ideas of the engineers of various cities. The peculiar conditions attached to ash, rubbish and garbage removal in municipalities have been given due consideration in the design of both trailer and body. The combination of trailer and body is covered by patent. We know that our readers will be interested in this trailer, as so far a lot of miscellaneous equipment has been put in operation for the purpose of garbage and ash hauling which as far as we can ascertain, has in no case been entirely successful. The equipment described has been tested under the most severe conditions over a period of several months and it has stood up under the most extreme conditions.

The outstanding features which cover, as far as we are able to ascertain, all the requirements of the city engineers in various cities might be briefly stated as follows: First, low price; second, interchangeability of the trailer equipment with other bodies for other uses; third, simple construction in both trailer and body, guaranteeing low rate of depreciation and long life; fourth, possibility of operating trailer and turning it around in narrow alleys; fifth, simple body construction, assuring complete discharge of the load; sixth, loading edge from ground, 2½-yard body 59", 3½-yard body 62"; seventh, when body is dumped the lower edge of body clears the dumpage; eighth, body is under constant control of cables, thereby eliminating the jumping off of the body from the trailer; ninth, quick operation, as it takes only fifty seconds to raise the body to complete dumping position and after dumping the body returns to its horizontal position by gravity; tenth, light weight of the entire outfit in comparison with the usual drop frame construction, which will permit hauling by mules or horses as well as tracks.



The double dump body as it is carried—low enough to permit ready loading, and in raised position for dumping

Wheels Require Inspection

FLEET owners naturally have among their drivers the good, the bad and the indifferent. And since expert supervision is, therefore, indispensable, the service manager becomes responsible for keeping the equipment in first-class condition. If he is a competent man, a large share of his time will go to motor truck inspection because this is the only way he can detect minor troubles in time to keep his machines out of the repair shop. Even this service manager, with all his mechanical knowledge, often will overlook the wheels. The reason for this lapse is simple enough: Barring accidents, this man may have handled motor trucks for years without a single wheel-repairing job. The very fact that wheels stand up so well causes him to take their good performance for granted and leave them out of his inspections just as instruction books on motor trucks leave them out of their list of necessary attentions.

Other parts subjected to punishing duty demand expensive upkeep. Not so with wood wheels. All they ask is an occasional coat of paint to preserve the wood grain from the elements. If this small attention is given promptly when needed, the wheel will perform almost indefinitely. Occasionally the hub bolts require setting up, a few minutes and a handy wrench is all that is necessary.

Rolling Fish Market Latest Commercial Vehicle

ONE of the reasons advanced for the high cost of food products is the number of steps necessary in transporting them between the source of supply and the ultimate consumer. If this is true, people in the vicinity of Atlantic City should be able to obtain their sea food at considerably less cost than people can who are not served by the rolling fish market illustrated in accompanying exterior view. This automobile fish market supplies fresh fish to various inland towns and uses Atlantic City as a headquarters and operating base. The truck body has spacious show windows and is provided with a refrigerating system that keeps the fish in good condition. A supply of over a ton of fish can be carried and five or more patrons can be waited on at a time inside of the commodious body. The ideals of the modern shop keeper are carried out inasmuch as the store is clean, electrically lighted and equipped with modern computing scales and a cash register. The extensive body sides permit the enterprising merchant to advertise his wares in an unmistakable manner and to proclaim to all who care to read that they operate their own fishing boats, bring the product directly from the producer to the consumer and as an added inducement they intimate that there is no middleman's profit though they do not go so far as to state whether or not the customer gets the benefit. The natural inference would be that communities served by this enterprising fish company not only procure sea food of good quality but obtain it at prices which make the enterprise mutually profitable. This is an upkeep cue.

A mobile fish market is the latest commercial body application

A New Form of Hydraulic Propulsion

(Continued from page 301)

through *A* divides and passes into the impeller through the unmasked portions of the holes in the sides of the drum. This internal drum can be rotated about the impeller shaft by means of the lever shown and can be held in any desired position. When it is set as shown in the drawing, the orifice for the discharge stream is of maximum area and the pump is set for full speed ahead. If the drum be rotated clockwise, the effective area of the discharge port and also of the inlet ports is reduced. As a consequence, the volume of water handled by the impeller and the speed of the vessel is lessened. In the extreme position, as shown in dotted lines, the inlet ports and the outlet port are completely masked, the impeller merely churns the water inside the casing, and the engine is practically relieved of the load. Consequently, no mechanical clutch is required between the engine and the pump.

Now, let us suppose that the inner drum is rotated anti-clockwise from the position shown in the side view. The effect is first to decrease the outlet orifice and throttle the discharge stream. The continuation of the rotation results in the passageway *A* being increasingly opened by the orifice in the periphery of the drum, while the unmasked portions of the side orifice remain substantially constant in area. In this condition a portion of the discharge stream is sent rearward and a portion forward through the passageway *A*. If the movement be continued a point will be reached at which the momenta of the two portions are equal and the vessel will remain stationary, although the engine is running under full load. Still further rotation will result in the entire discharge stream being delivered forwardly to *A*, when the propulsive equipment will immediately develop full speed astern.

Since the two pumps are controlled independently, one may be set full ahead and the other full astern, and the boat can be turned within its own length; in fact, the course of the vessel can be controlled by the pump only, if so desired. In its investigation of this very interesting experimental boat, *The Engineer* found that the speed developed at 950 revolutions and 7¾ brake horsepower was 5.6 knots, and the calculations by Mr. Hotchkiss, the inventor, showed a jet efficiency of 73 per cent. He assumes the efficiency of the pumps at 90 per cent, and thus arrives at a propulsive efficiency of 65.7 per cent. Taking the engine efficiency at 75 per cent, the over-all efficiency works out at 49.3 per cent. This, *The Engineer* considers would be a fair showing in a vessel propelled by the old screw propeller, although our contemporary takes no responsibility for the data on which the calculation is based.

It should be mentioned that the pumps can be arranged to draw their supply of water from within the hull, in the event of the vessel being holed: and if the pumps are capable of handling in twelve seconds or so, as is claimed, a weight of water equal to the displacement of the vessel, they should be able to salvage a craft in which they were fitted, even though it was very seriously injured.

Germany's Brown Coal

(Continued from page 304)

From the driers the coal goes through pulverizers which reduce it to fairly uniform size; thence the powdered material is shifted mechanically to a cooling room, fitted with slanting floors or shelves over which it drops by gravitation; and at the bottom of the cooling chamber the lignite is in a condition to be handled by the briqueting presses to which it is led directly. The presses are of the open-mold plunger type, which subject the powdered brown coal, containing about 15

NEW BOOKS, ETC.

PERSONNEL ADMINISTRATION. Its Principles and Practice. By Ordway Tead and Henry C. Metcalf, Ph.D. New York: McGraw-Hill Book Company, 1920. 8vo.; 538 pp.

The fallacious but still dominant formula, that results are directly proportional to the power of enforcing obedience, falls to cover the complex relationship between managers and managed. We glimpse the fact that the quality of the obedience as determined by the mental reactions of the managed is overwhelmingly important—economically as well as sociologically, if indeed the two factors are ever sunderabe. In "Personnel Administration" we find a sane balancing of these constituents, a comprehensive survey of the field, an evaluation of educational and health elements, specific research, the coördination of departments, and joint relations. Vital topics are logically grouped and suggestively handled for the benefit of students, executives and employers. The best practice from innumerable sources is incorporated in the volume.

DIRECT-CURRENT MOTOR AND GENERATOR TROUBLES. By Theodore S. Gandy and Elmer C. Schacht, Lt. J. G., U.S.N.R.F. New York: McGraw-Hill Book Company, 1920. 8vo.; 274 pp.; illustrated.

This is in the main a compilation of the simplest and most effective methods of tracing and correcting troubles, preceded by adequate descriptions of the various types of motors and generators, and their uses. There is also an analysis, from the operator's standpoint, of problems centering about operation, care, and repair. The illustrations are necessarily taken from standard machines, but the instruction is so given as to be general, and applicable to the operation of all types. The question, "What is the matter?" confronts the operator again and again; in giving a true, understandable answer, this handbook fills a daily need.

AMERICAN MACHINISTS' HANDBOOK AND DICTIONARY OF SHOP TERMS. By Fred H. Colvin and Frank A. Stanley. New York: McGraw-Hill Book Company, 1920. 16mo.; 758 pp.; illustrated.

Shop and draughting-room are not immune from change, and this third edition of a work that is creating many friends for itself takes the changes into due consideration and adds much timely information. Mathematics being the heart of mechanics, the tables and data here carefully selected and brought together, some of them from almost inaccessible sources, will soon pay for the elbow-room they occupy; tools, processes and accepted practice are treated at length; shop and drawing room standards, horse-power, belts and shafting, and shop trigonometry are presented in convenient arrangement, and the illustrated dictionary of terms is a valuable feature.

MECHANICAL DRAWING FOR HIGH SCHOOLS. A Text with Problem Layouts. By Thomas E. French and Carl L. Svensen. New York: McGraw-Hill Book Company, 1919. 8vo.; 221 pp.; illustrated.

In many ways this is an exceptionally good text, and will be recognized as such by the industrial educator. More than the ordinary care has gone to teaching the best ways of using the drawing board and instruments; shape visualization and description are rightly treated as of prime importance; other expositions include the technic of the finished drawing, mechanical and architectural practice, and graphic solutions and sheet-metal drafting. Eighty pages of problems cover all phases of the study, and the instructions are amply illustrated.

HUMAN AND INDUSTRIAL EFFICIENCY. By Henry Chellew, Ph.D., D.Sc. Preface by Rt. Hon. Lord Sydenham, F.R.S. New York and London: G. P. Putnam's Sons, 1920. 12mo.; 149 pp.

This short study of the factors of efficiency recognizes two fatigues, "and the most important is that of the mind." Lord Sydenham, in his preface, lays unrest at the door of our neglect of the psychological requirements of the human machine, and the author, whose instruction at the University of London will be remembered by many American officers, writes as practical philosopher rather than as engineer. His synthetic study gives brief glimpses of the broad field, and is but the forerunner of a projected volume that will deal more exhaustively with vocational adaptation and training.

MOTOR QUERY ENCYCLOPEDIA. Cincinnati: American Automobile Digest, 1919. 16mo.; 129 pp.; 160 illustrations.

A very large proportion of our people are practically interested in motors. Questions as to cause and effect are continually arising in their minds. The chances are that you will find your pressing question of the moment formulated in this little handbook, and answered to your full satisfaction. Axles, batteries, chassis, clutches, cooling, lighting, ignition, steering gear, transmission—in short, everything about the car is explained in brief, simply-worded paragraphs.

HYDRAULIC TABLES. By Gardner S. Williams, M.Am.Soc.C.E. and Allen Hazen, M.Am.Soc.C.E. New York: John Wiley and Sons, 1920. 8vo.; 115 pp.; illustrated.

These important tables, accompanied by brief explanations, deal with gagings, the friction of water flowing in pipes, sewers, etc., as determined by the Williams-Hazen formula, and the flow of water over sharp-edged and irregular weirs and the quantity discharged. There is a new chapter of additional data in this third edition, and a graph showing the relations of the chief results both new and old. These tables have proved their value in fifteen years of use.

MEXICO IN REVOLUTION. By V. Blasco Ibañez. Translated by Arthur Livingston and José Padin. New York: E. P. Dutton and Company, 1920. 8vo.; 245 pages.

Ibañez, caught in the "vertiginous" storm of a Mexican revolution, tells us how it all came about. These articles first appeared in American newspapers, and they constitute a chatty, keen account in which Mexican society, character, and politics parade before the edified reader. Bonillas, Obregon and Gonzalez are drawn with a sure hand, the condition of the country is set nakedly before us, and in the final chapter, on Mexico's attitude toward the United States, amusing and serious elements mix to define a situation of which we should all have more knowledge.

A MANUAL OF THE TIMBERS OF THE WORLD. By Alexander L. Howard. New York: The Macmillan Company, 1920. 8vo.; 446 pp.; 100 illustrations.

This notable handbook is intended to supplement rather than to supersede other works. The characteristics and uses of all commercial timbers are alphabetically catalogued, pictured, and described. Other material includes the conversion and preservation of timber, specifications and conditions of contract, Laslett's tables, a classification of timbers according to the country of origin, and a bibliography. The section by S. Fitzgerald, on artificial seasoning, is a noteworthy feature, and there is an index to scientific names in addition to the general index.

SURFACE WATER SUPPLY OF THE UNITED STATES. 1917. Part I. North Atlantic Slope Drainage Basins. Washington: Government Printing Office, 1920. 8vo.; 200 pp.; 2 plates.

Data collected by the Geological Survey during 1917, and presenting results of measurements of flow made on streams, occupy 14 reports, of which this is one. It describes the typical gaging station and its equipment, and tabulates the records of the North Atlantic Slope.

AMERICAN LUBRICANTS. From the Standpoint of the Consumer. By L. B. Lockhart. Easton, Pa.: The Chemical Publishing Company, 1920. 8vo.; 341 pp.; illustrated.

The difference between this and most other books on lubrication is indicated in the subtitle; the user's interests are made paramount, and the buyer and consumer of oils and greases is taught to select intelligently those best suited to his purposes. From crude petroleum to its refined products, characteristics and properties are described; solid and fluid friction and the lubricants and systems dealing with them are discussed; following this come chapters on the demands of special machinery, from the internal combustion engine to the steam railway. Mills and plants of all kinds are considered, and tests, analyses, and up-to-date specifications are dealt with at great length. Important tables conclude the informing and helpful work.

THE COLONIZATION OF NORTH AMERICA. 1492-1783. By Herbert Eugene Bolton, Ph.D. and Thomas Maitland Marshall, Ph.D. New York: The Macmillan Company, 1920. 8vo.; 609 pp.; 49 maps.

Eastern insularity may be to blame; however that may be, it is a fact that most of our works on colonization are devoted to the thirteen English colonies, slighting France, dismissing Spain with a word, and largely ignoring Holland, Sweden, Russia and Denmark. The substantial volume in hand corrects this narrow viewpoint and brings local developments together as integral parts of a complete picture. It rehearses the whole drama of civilization in North America, with strict attention to time sequence and the comparative importance of racial activities. This breadth of treatment is commendable, and readers will gain from it an expanded consciousness of the multiplex factors that left us what we were at the close of the Revolutionary War.

FUEL OIL IN INDUSTRY. By Stephen O. Andros, A.B., E.M. Chicago: The Shaw Publishing Company, 1920. 8vo.; 244 pp.; illustrated.

The principles of fuel oil combustion and its physical and chemical properties are here outlined in a highly satisfactory manner. There is a comparison of coal and oil fuel, a chapter on colloidal fuel, and a long and valuable discourse on distribution and storage. Other chapters treat of heating and pumping; boiler furnaces; fuel oil burners; fuel oil in steam navigation, locomotives, iron and steel manufacture, the production of electricity; in the sugar, glass, and ceramic industries, the heating of buildings, and the making of gas. The publication is timely, the theme well handled, and the appeal wide.

A COURSE IN PRACTICAL MATHEMATICS. By F. M. Saxelby, M.Sc., B.A. New York and London: Longmans, Green and Company, 1917. 8vo.; 472 pp.; illustrated.

This thorough course takes cognizance of the needs of the technical student. The deductive treatment is accompanied at every step by graphic or arithmetical verification; the arbitrary system of symbols is illuminated by the facts of experience. Thus the mind is gradually prepared for the analytical methods of differentiation, and trigonometry is made comprehensible to the earnest student. The same method is extended to the mastery of definite integration, and the best educational order of subjects is followed, rather than the merely logical or historical order.

THE CERAMIC INDUSTRIES POCKET BOOK. By Alfred B. Searle. New York: Isaac Pitman and Sons, 1920. 16mo.; 267 pp.; illustrated.

From various sources this manual takes information that has been of practical assistance to those engaged in the clay-working, glass, and allied industries, and arranges it in convenient form. It describes materials, gives data on water and steam, briefly treats of mechanics and dynamics, gives pertinent facts relating to machinery and burning and kilns, and presents ceramic calculations. A bibliography and a list of technical and other associations round out a handbook of high value to students and workers.

DICTIONARY OF EXPLOSIVES. By Arthur Marshall. Philadelphia: P. Blakiston's Son and Company, 1920. 8vo.; 159 pp.

Those who are acquainted with Mr. Marshall's authoritative works on explosives will be glad to note this up-to-date dictionary, which replaces old books of a similar nature. Very little is included beyond explosives with special or proprietary names, so that practicality is assured. We find those used in British, American and European coal mines, in blasting, in shells, bombs, shotguns and rifled firearms; descriptions and formulas are given, and there is an index of constituents.

A TEXT-BOOK OF PHYSICS. By Louis Bevier Spinney. New York: The Macmillan Company, 1920. 8vo.; 617 pp.; illustrated.

Professor Spinney has taken pains to make the fundamental subject of mechanics as interesting and understandable as possible to the college student. Heat, electricity, sound and light are so presented as to include descriptions of all experimental laws and phenomena that directly contribute to a logical development of general physics without becoming digressive. A knowledge of algebra, geometry, and the trigonometrical functions is assumed; practical aspects are emphasized, illustrations use mainly familiar phenomena, and principles are exemplified by investigating their applications.

A GUIDE TO THE MILITARY HISTORY OF THE WORLD WAR. 1914-1918. By Thomas G. Frothingham, Captain U.S.R. Boston: Little, Brown and Company, 1920.

It is exceedingly difficult to find within a year or two after a war, a history of the conflict treating events in their proportional importance, or with anything like a true perspective. Yet the consensus of military opinion seems to be that Capt. Frothingham has accomplished this feat. His narrative synopsis covers the strategy and grand tactics of the whole war. Students and the general reader should find the outline invaluable as a check against the misleading tendency of phase study and as a guide in forming a clearcut, orderly conception of the wave-action of the forces employed. The author's analysis of the battle of Jutland is a striking instance of his critical, descriptive and deductive powers.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

GARMENT FASTENER.—B. A. SHAMMO, 106 W. 79th St., New York, N. Y. This invention has for its object to provide a construction which may be easily attached to the garment and which in operation will properly hold the garment while permitting easy engagement or disengagement. A further object is to provide a fastener in which a bridge and interlocking tongue are used, and giving the finished appearance of a rounded button.

SHOE FASTENER.—B. A. SHAMMO, 106 W. 79th St., New York, N. Y. This invention relates to a fastening device which is especially adapted for use with shoes. An object is to provide a fastener wherein a proper clasping action is secured when first used, and means are presented which will permit a readjustment of the parts to maintain a desired position of the garment fastened, and which will thereby automatically take up any stretching or distending of the material of the article.

Electrical Devices

SWITCH FOR FLASH LIGHTS. — H. M. KORETZKY, c/o Bright Star Battery Co., 310 Hudson St., New York, N. Y. More particularly the invention relates to a switch for intermittently or continuously closing the circuit of the battery and lamp. The general object is to provide a combination of push-button and slide button so arranged that they are employed independently for closing the circuit by engagement with the contact strip within the casing of the flash light.

STORAGE BATTERY.—P. M. MARKO, 1191 Bedford Ave., Brooklyn, N. Y. The invention has for its general object to provide a form of jar cover which permits of the level of the electrolyte to be easily and quickly ascertained without removing the vent or filling plug; this is accomplished by the making of the cover of transparent pressed glass of special design, and within the cell are two distinctly colored arrows attached to the terminal posts, which serve as means for determining the proper level of the electrolyte.

ELECTRIC SWITCH.—A. M. CONDIT, 19 Essex St., East Orange, N. J. The object of the invention is to provide an electric switch arranged to permit of conveniently closing an electric circuit temporarily or for any length of time according to the desires of the user, and without requiring his attention for the time being. Another object is to permit of conveniently attaching the switch to a desired support on an automobile for use in signaling devices to enable the operator to control the display signals.

BLASTING APPARATUS.—S. T. HOAR, 2216 Cottonwood St., Meaderville, Mont. The invention relates to electrical apparatus for use in blasting, and has particular reference to a switch adapted for closing a number of circuits for exploding electric primers. A further object is to provide an explosive charge which may be completely assembled before being distributed to the miner, so that all the miner need do is to place the same in the hole to be blasted and connect it in the circuit.

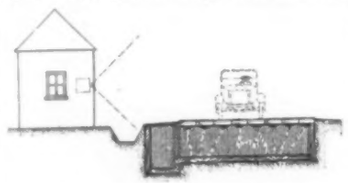
ELECTRIC LIGHT FIXTURE.—B. B. STENVALL, 521 45th St., Brooklyn, N. Y. The invention has for its object to provide a fixture of the type generally employed on a desk, the important features residing in means for variously adjusting the light, novel supporting means and the manner of arranging the conductor cord with respect to the adjustable and supporting elements, whereby the light may be employed as an effective and convenient searchlight.

Of General Interest

GARMENT HANGER.—M. ROSENTHAL, 501 W. 170th St., New York, N. Y. Among the objects of the invention is to provide a garment hanger which in addition to supporting a coat, or similar article, is capable of supporting a plurality of other garments, and also has the advantage of having the supports for the other garments removably attached. The device may be formed of wood or metal, and either rigid, or foldable for convenience of travelers.

STONE MOUNTING.—A. L. ELIASOFF, and C. BIRNBAUM, 80 Nassau St., New York, N. Y. The invention relates to jewelry, and more particularly to ornamental gem settings. An object is to produce a stone setting having a light reflecting medium which adds to the charm and luster, and also provides means for securely anchoring a precious stone in the prongs of a ring, the prongs being protected from wear, thus decreasing the possibility of the loss of the stone.

TRAFFIC REGISTER.—G. HENRY, 55 d'Artigny St., Quebec, Canada. It is the purpose of this invention to provide a sytematic, automatic and continuous registration of the actual traffic at any point on a highway. The object being to provide an apparatus which will



A VIEW IN SECTION, SHOWING A VEHICLE PASSING THE POINT OF OPERATOR

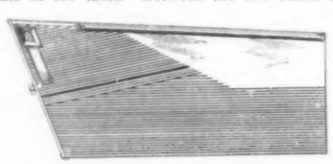
take an instantaneous photograph of traffic on a street or road, so that vehicles of all speeds can be photographed as they pass a given point in such form that the film may later be used as a permanent record in connection with a projecting device.

ARTIFICIAL LIMB.—J. W. SMITH, 1621 Francisco Ave., Chicago, Ill. It is one of the objects of this invention to provide an artificial arm which is capable of use in cases where the natural arm has been amputated either between the shoulder and elbow or between the elbow and the wrist. A further object is to construct an artificial arm in such manner that the forearm section is movable with relation to the upper arm section, the hand section universally movable with respect to the forearm, and the finger sections movable with respect to the body portion of the hand, the finger sections having means to cause them to grip articles of various sizes.

MOVING PICTURE CAMERA AND PROJECTOR.—D. TAIFIRNOPOULOS, 67 Cherry St., New York, N. Y. An object of the invention is to provide means wherein the parts may be quickly and easily adjusted or rearranged to act as a camera or as a projecting machine. A further object is to provide a simplified and small construction for family use, the structure being such that a minimum of space will be required for its use.

SNAP ORNAMENT FASTENER.—N. BANDELL, address L. M. Friedman, 233 Broadway, New York, N. Y. The invention relates to an ornamental stud or button. An object is to provide a snap fastener which is adapted for use as an ornament or as a fastening means for a garment, and which permits the removal of the stud during the laundering operation of the garment so that the ornamental exterior of the fastener will not be broken or injured.

CONCENTRATING TABLE.—J. F. MCNEIL, Death Valley, Cal. In order to obtain a larger proportion of concentrates and increase the capacity of the table with minimum power, this patentee arranges a series of oblique riffles inclining upwardly toward the high side of the table and adjacent to the opposite side, or tailing discharge, are riffles parallel with the axis of the table. Between the two series of



PLAN VIEW OF THE TABLE

riffles is a bank riffle the top surface of which slopes toward the tailing side, all the riffles being gradually of reduced height toward the discharge end of the table. A feed device extends across the oblique riffles and there is essentially a feeding to all the riffles adjacent the head of the table. The bank riffle results in a pond being formed at the area of the oblique riffles. The material is required to travel upward toward the high side of the table before escaping to the table surface to be carried laterally toward the parallel riffles.

DEVICE FOR USE IN LEARNING TO SWIM.—G. JORDAHN, Palm Beach, Fla. The invention relates more particularly to an inflatable device adapted to encircle the body and to be positioned in such manner as to preclude accidental displacement. The device is provided with means for readily tying the ends of the tube, which tying serves the double function of retaining air in the tube and properly holding the tube around the body.

CLOTHESLINE CLAMP.—W. A. JOHNSON, 202 Quincy St., Fairmont, W. Va. Among the objects of this invention is to provide a simple, inexpensive and efficient metal hook and eye clamp which will effect a locking of the clothes line to the prop so that accidental displacement of the line is positively prevented; the only way in which the line can be removed from the clamp is by manually removing the eye from the hook.

CONTAINER FOR CEDAR SHAVINGS.—J. E. TRACY, Box 839, Orlando, Fla. The invention relates to a comparatively small box which may be placed in a trunk or clothes closet for preventing moths from attacking the clothes. The purpose is to provide a container which will allow of the exposing of cedar shavings to the air at the same time preventing the shavings from being displaced.

STORE SIGN.—B. H. SCHARF, 635 W. 170th St., New York, N. Y. An object of the invention is to provide a sign with a changeable display to be mounted on the door and readable through the glass of a store door or other institution having public patronage to announce whether or not the store is open or closed, and to further announce good will and a spirit of welcomeness to customers entering and leaving.

HUMIDIFIER.—L. A. SMITH, Port Gibson, Mississippi. This invention has for its object to provide a small portable humidifier capable of being carried in the pocket if desired by means of which a cigar may be simultaneously moistened and impregnated with a flavoring by drawing a blast of air laden with the flavoring through the cigar.

Hardware and Tools

RAZOR.—D. A. FENWICK, Box 222, Bisbee, Arizona. The invention relates more particularly to a razor having a removable double edged blade supported in a holder or frame which has the general appearance of and operates in the same way as the ordinary old style razor. An object is to provide means for securing the razor in the holder and permitting the use of a thin steel double edged blade which can be sharpened on an ordinary strop and cheaply manufactured.

CURTAIN ADJUSTER.—E. M. MENZL, cor. Riker and Steinway Ave., Steinway, Long Island City, N. Y. Among the objects of the invention is to provide a neat and inconspicuous cross bar, which when in operation will hold a lace curtain well spaced from the window sashes so as to afford a free flow of ventilation, and prevent the blowing of the curtain or the soiling thereof, and permit unobstructed cleaning of the window and other purposes.

COMBINATION SCALE JACK. — C. D. STEELE, 59 W. 44th St., New York, N. Y. The invention relates to a device such for example as lifting jacks and weighing or load indicating devices. Among the objects is to provide a relatively simple implement easily manipulated by any ordinary person for the purpose of checking the weight of loads such as coal, grain or hay, when carried either on horse-drawn or self propelled vehicles.

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per cent of moisture, to a pressure of from 18,000 to 22,500 pounds per square inch. The briquets are lozenge-shaped, 7 inches long, and 2½ inches wide, weighing 1 pound each. No binder is required because the heat of compression liberates from the lignite sufficient tarry matter to insure adhesion. Each press has a capacity of 77 short tons of briquets during a 24-hour run; and 120 horsepower are required for its operation.

Because the briquets are very hot when first molded, it is necessary to cool them to guard against ignition if they be piled immediately. Therefore, they drop from each press into a trough-shaped conveyor which moves the briquets to the storage sheds; and this journey of 325 feet is long enough to chill them sufficiently.

Shortly before the war a large central power station for the generation of electricity was placed at a brown-coal mine in the Cologne district, and was able to furnish current to that city at the rate of about ¾ cent per kilowatt hour. Two years ago Mr. George S. Rice of the Bureau of Mines was in that neighborhood, and at the Fortuna mine he visited a central station which was developing 40,000 electrical horsepower and transmitting that energy to Cologne 12 miles away. Such of the brown coal as was not burned under the boilers was being made into briquets, which were used in competition with bituminous coal both on the railways and for factory and domestic use.

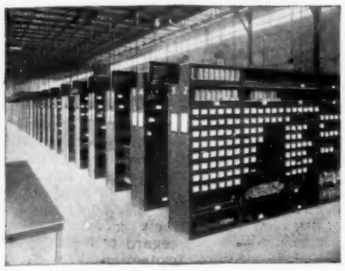
It has been proved by the Germans that boilers can be constructed that will work well when fired with either hard-coal or brown-coal briquets. It seems that the heating value of either fuel is substantially the same for continuous operation. Brown-coal briquets, however, are less suitable for intermittent service. A well-known German engineering concern has recently developed a special boiler for the use of brown-coal briquets and even inferior grades of fuel, and the tests have been highly satisfactory. The efficiency is reported to have run between 78 and 84.2 per cent.

How great this industry is can be readily grasped from the following comparative figures: In 1913 the brown coal output totaled 79,741,825 tons, and last year it aggregated 121,202,215 tons. Relatively 5 per cent less of the lignite production was worked into briquets during 1920 and this probably indicates not only the wider direct burning of the raw brown coal for the development of power but gives us an inkling of that other line of activity which is engrossing many of the best technical minds of Germany—the dry distillation of this low-grade fuel, in which notable results have been achieved.

Not quite a year ago the German Government determined to regulate the coal-tar trade, and called into being the "Economic Union for Crude Coal Tar and Coal-Tar Products." Prior to the war Germany obtained, in round figures, 380,000 tons of tar oil from coal; and her lignites yielded about 47,000 tons of paraffin oil, gas oil, etc. In 1919 there was produced from coal substantially 300,000 tons of tar oils, but, according to the Treaty of Versailles, Germany must deliver annually, for a period of three years, no less than 35,000 tons of benzol and 50,000 tons of coal tar or products distilled therefrom. Naturally, stripped as the Teutons are of so much of their black coal region, they must make the most of the native lignites in order to meet their own wants and to satisfy the terms of peace. It is estimated that 50,000 tons of tar oils were distilled from brown coal in 1920.

War-time experiments revealed that the distillation of lignites, at high temperature, would give a liquid coal tar which contains certain ingredients that could be substituted for gasoline, kerosene and lubricating oils. Through a later process it is possible to get benzine and kerosene from coal tar distilled from brown coal at a lower temperature; and by reason of this development all industries that can do so are being urged to provide them-

DURAND
STEEL RACKS



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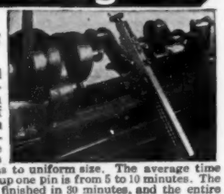

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selves with facilities for this purpose. To this end, the authorities have put a premium upon the distillation of lignites by promising to remit the coal tax in the case of the brown coal so treated.

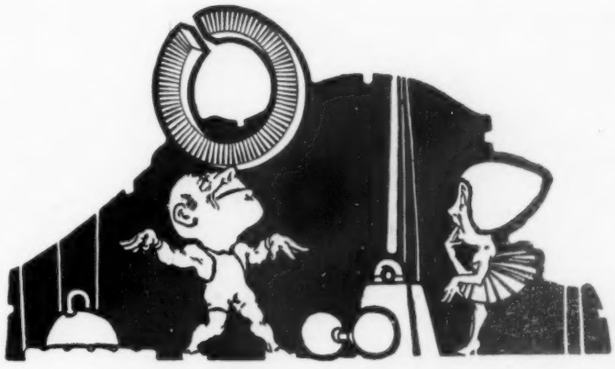
About a year back a German technicist stated, in making an address before the Prussian Ministry of Public Works, that one ton of brown coal would yield enough gas to generate 408 kilowatt hours of electricity, and provide in addition 77 pounds of tar, 8.8 pounds of pitch, 8.8 pounds of paraffin, 8.8 pounds of "solid oil," and 22 pounds each of two other kinds of industrial oils. At that time the expert said that a method had been discovered by which edible fats, suitable for the manufacture of margarine, could be derived from this coal tar, and it seems that soap has been made from the same source.

Another consequence of the peace treaty is Germany's obligation to give to France each twelvemonth also for three years 30,000 tons of ammonia, and here, again, brown coal comes to the rescue. While this discovery of industrial salvation is heralded as another proof of Teuton technical cunning, it serves the while to confirm independent work done on this side of the Atlantic by some of our own people even before the World War. It was found here that from the distillation of lignite it would be practicable to realize approximately 17.4 pounds of ammonium sulphate per ton of the dried fuel, and the Germans are turning this fact to good account in the treatment that they have adopted.

It is now well known that lignite, if carbonized at the relatively low temperature of about 1,200 degrees Fahrenheit, will give off gas freely, and that the by-products recovered will be of satisfactory quality. Above that temperature the destructive distillation of the tar in the raw fuel begins, and the greater heat not only reduces the amount of recoverable tar but affects the character of that material and the oils that may be subsequently obtained from it. It has been established that heavy oils from lignite tar are admirably suited for use in internal combustion engines because the oil does not deposit tarry matter. And what is of equal significance, lignite gas is what is termed a "dry" gas—*i.e.*, it is substantially free from tar, and gives no troublesome condensation when distributed through slightly protected pipes even in cold weather. The gas is well adapted to power purposes.

Probably one of the most interesting phases of the dry distillation of brown coal or lignite is that the carbonized residue, of very little value in the form in which it comes from the retort, may nevertheless, be converted into a really excellent smokeless fuel by briqueting. Indeed, briquets of this nature are distinctly superior to those made from dried brown coal. Comparative tests with high-grade bituminous coal have shown carbonized lignite briquets to be more efficient. For instance, 3.76 pounds of briquets and 3.88 pounds of soft coal were severally required to develop a horsepower hour; the quantity of water evaporated per pound of fuel was, in the case of the briquets, 9.18 against 8.88 pounds on the part of the bituminous coal; and the average boiler horsepower developed was 98 with the soft coal and 101.5 with the briquets.

It should be kept in mind that, by exhaustive distillation and treatment of the tars and oils, it is practicable to derive hundreds of synthetic products, such as paraffin, acids, antiseptics, photographic chemicals, aniline dyes, drugs, perfumes, preservatives, etc. From the light oils can be got benzol, toluol, dyes, photochemicals, certain drugs, etc. From the carbolic and creosote fractions are obtained carbolic acid, creosote, picric acid, photodyes, coloring materials, perfumes, etc. The anthracene oils yield, among other things, alizarin, valuable acid used in the production of dyes, and carbolineum, effective as a wood preservative.



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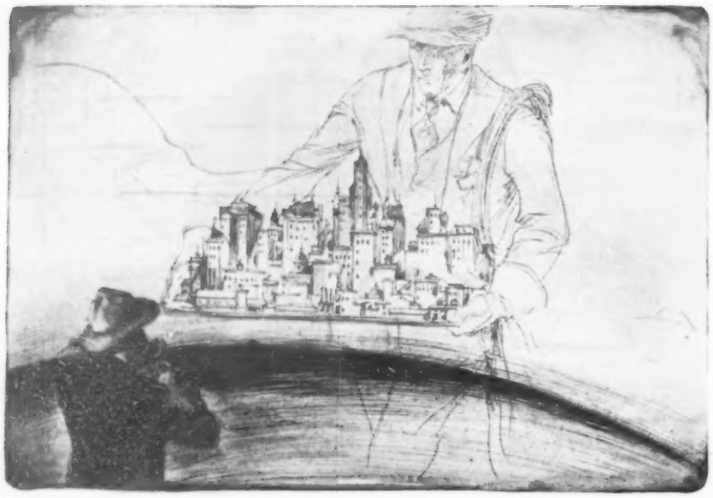

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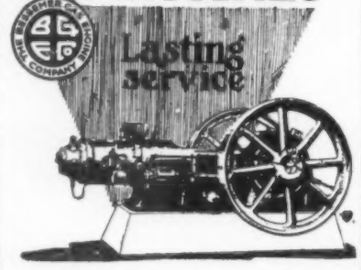

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From Brewing Beer to Raising Mushrooms

(*Continued from page 305*)

vated mushrooms to similar conditions. After the beds are planted and allowed to germinate, they are wetted down not as by a shower, but by the better method of producing in the room a heavy fog. This is done by the use of steam and the refrigerating apparatus. For a time there is maintained a fog so dense that one can hardly see one's hand held at arm's length. When the beds have reached the proper degree of saturation the air is cleared within a few minutes and a slow drying process begins. It is during the drying out that the mushroom growth takes place. Appearing within a few hours as little white balls, they grow steadily until within a week they are "ripe."

A mushroom is ripe, it is explained, when the delicate skin or membrane on the under surface is still unbroken, but gives to a slight pressure of the thumb. If the membrane which protects the "gills" is already broken the mushroom is overripe and decay will begin very soon.

Carrying still further the idea of reproducing the atmosphere of a thunder storm, a large static machine was obtained and continual discharges of artificial "lightning" were produced during the period of growth. The subtle change this produced in the atmosphere was found to have a very marked effect on speed of growth and size of the product. Since the power required to operate the static machine was very small and the results quite noticeable, the machine will be made a permanent part of the equipment.

There is probably no fruit or vegetable which deteriorates so rapidly after picking as does the mushroom. Most of the cultivated mushrooms offered on the market, are, under the best of conditions, from three to four days old. By that time they have lost considerable weight and, according to connoisseurs, much of their delicate flavor.

The sales plan of the new "plantation" contemplates having the mushrooms served within three or four hours of the time they are picked. So far the large New York hotels have taken the entire production and even the demand from this source could not be met. Several of the New York hotels use a hundred pounds of mushrooms a day. No customer is allowed to order more than he can use in a single day and deliveries are made every day within an hour or two after picking.

Testing Roadbed Conditions by the Resistance Method

(*Continued from page 305*)

current of from 25 to 35 amperes. The current entering the rails flowed away from the test station in both directions, leakage taking place to the earth and the current was picked up by the water-piping system and returned to the negative pole of the battery. A milli-voltmeter was used in measuring the loss of current between two stations, several thousand feet apart.

Roadbeds having a foundation of clean, crushed stone under a concrete paving base offer a higher resistance than structures with a solid concrete ballast. Trackage with a full crushed stone ballast and a Tarvia finish offers a high leakage resistance, which is of the order of 2 to 5 ohms for 1,000 feet of track. Where the ties are buried, insuring a moist condition, resistance is lower than that of open-construction roadbeds, being from 1 to 1.5 ohms for 1,000 feet of single track. The theory that open-construction track is insulated from the earth is not supported by facts. Zinc chloride and other chemical salts used as preservatives render ties highly conducting and increase leakage currents from the tracks.

Summarizing the moral that these investigations would teach the Bureau of Standards, offers some suggestions to elec-

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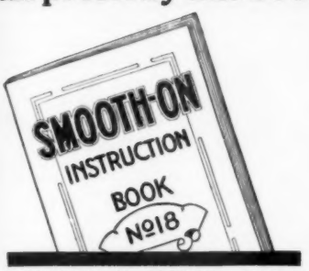

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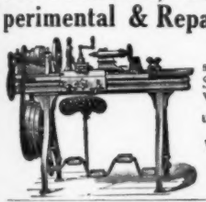

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tric railway companies for minimizing the leaking of currents from trackage. Abandon solid concrete ballast, substituting crushed stone as foundation under ties; when using crushed stone or gravel protect it with coverings or pavement; use of salt as an antifreezing remedy on switches should be avoided inasmuch as it reduces the resistance of roadbeds; rails, bored by open construction, should be removed from contact with earth.

Solving the Labor Problem—V

(Continued from page 306)

$80 to $300, or even more, in training a man to do one's work acceptably it is obviously not good policy to allow that investment to be jeopardized by the unrestrained vagaries of a temperamental foreman or higher officer.

So there is a growing tendency to restrict the powers of the foreman who, so far as the average employee is concerned, personifies the company. Workmen are hired by the Employment Director and his staff of urbane interviewers. Separating the sheep from the goats in the horde of applicants is only the preliminary task of the Employment Director. Having controlled the sheep it is his duty to see that their first impression of the plant is a favorable one and thereafter to see that the first impression is strengthened. Human nature is the same the world over. Many a promising prospect for a shop that needed him has been lost because the prospect did not approve of the foreman's manner of receiving him on the first day.

The foreman can no longer discharge a man without the advice and consent of the Employment Director unless for some peculiarly flagrant transgression. Neither are old-fashioned driving methods permitted to the foreman. Getting things done is now recognized as an art which calls for the exercise of diplomacy and a broad understanding of human nature, among other things.

Foremen are the raw material from which higher executives are fashioned. Once the upward climb has begun further training is found to be a prerequisite to promotion; so that he who seeks a career in industry or commerce must look forward to a continuous round of training which will end only when he is retired under the age limit.

If the anticipations of the National Association of Corporation Training are realized the third stage will be ushered in with the establishment of a great university under its auspices. This new type of university will offer no academic nor engineering courses, but will devote itself wholly to research in industry and commerce and to training men for careers in these fields or to go into colleges as instructors for the business army of tomorrow.

Preventing the Roll of Ships

(Continued from page 308)

The power consumed in running the heavy gyroscope is inconsiderable, partly because the runner spins in a vacuum. Data have been accumulated from the service performance of a fast passenger and cargo ship running over the same course in the same direction for ten consecutive trips of 4,600 miles each. Information has been made available in respect to the retardation due to variations in the weather. Using this as a basis, it is estimated that if the daily operation of 24 hours means an outlay of $6,000, then "the extra expense—that is, the expense over and above the average—in the stormy months amounts to not far from $100,000. This, taken with the amount saved through elimination of bilge keel losses, develops an earning capacity on the cost of the stabilizer of not far from 100 per cent per annum."

There is seen to be a great advantage in connection with the use of the stabilizer, when one perceives that the ship may be kept on her course, in beam seas, with unchecked speed when storm condi-

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tions intervene. It is understood that stabilized ships are able more closely to approximate the regular schedule, despite the occurrence of storms.

Bilge keels on vessels are useful when the ship is undergoing very heavy rolling. At other times, they are a disadvantage, since they effect retardation. Even when the weather is calm, the bilge keels retard the ship by skin friction. In bad weather, when the ship pitches, there are considerable displacements of water as the vessel pushes on. For the "Campania," a ship of 19,400 tons, the calm weather loss has been put at 840 horsepower, and the rough weather loss at 1,440 horsepower. It will be gathered that bilge keels are rather expensive, but they are ordinarily needed in very bad weather. If, however, the ship is equipped with a suitable stabilizing plant, the bilge keels may be omitted, since under these circumstances their occasional service—that is, during bad rolling—is much better performed by the gyroscope.

Cargo, as well as passenger, vessels are benefited with respect to the better care it is possible to take of the load being carried. When live stock is being transported, the advantage is almost obvious. A concern engaged in shipping horses during the Great War had losses running up to $30,00 or $40,000 in single trips. Such losses occur because of the bad rolling in heavy storms.

Finding Jobs for Radium

(*Continued from page 310*)

Valley, Colorado, more than fifty miles from the nearest railroad over a barren desert trail. It is a natural conclusion that the extraction plant would be located at the mines under such circumstances but such is not the case. The largest producer of radium carries the ore clear across the continent and extracts the radium in a plant at Orange, New Jersey. The reason is that for every ton of ore extracted, tons of chemicals and coal are required, and it is cheaper to move the ore to the chemicals than to move the chemicals to the ore.

The extraction process consists simply of eliminating the various substances in the ore until finally the radium alone is left. A ton of good ore contains approximately five milligrams of radium. A milligram is 1/1000 part of a gram and a gram is about 1/28 of an ounce. To obtain this tiny bit of material the ore is first ground and then put through scores of chemical elimination processes. It is mixed with other chemicals, allowed to settle in big vats, and passed through many strainers. The final processes are carried out in the laboratory under the utmost care. About 20 per cent of the radium is lost, but the remaining 80 per cent is finally delivered in little glass tubes in the form of a radium salt—such as radium bromide, radium sulfate, radium carbonate, or radium chloride.

Radium in its irreducible form is a metal, but as such it lacks stability and is therefore produced commercially as a salt. Indeed, the pure metal has been produced only once or twice and very few persons have ever seen it. It is described as a whitish metal having the appearance of the rare metals calcium or potassium.

In the reduction process considerable quantities of vanadium and uranium are recovered, and were it not for this fact radium would cost considerably more than $120,000 a gram—its present price. A famous expert on radium is authority for the statement that the law of supply and demand has very little to do with the price of radium. The selling price is set by the cost of extraction and the price can only be reduced as improved methods are found. Refinements in the process are constantly being made, but there is no immediate hope of any great reduction in price. Practical scientists place the thought that perhaps some revolutionary discovery will be made to eliminate much of the cost, in the same category with perpetual motion.

Radium emits three distinct rays: The alpha, which has been identified as positive static electricity and which forms about 90 per cent of the total emanations; beta, which is negative static electricity, forming about 9 per cent of the emanations; and gamma, which is a real ray—a vibration—and which forms the remaining 1 per cent of the emanations. In spite of the fact that the alpha rays compose most of the emanations, they have very little penetrating power; indeed, a sheet of paper will stop them. The beta rays are more powerful but can be stopped by about 1 centimeter of lead, while the gamma rays penetrate three or four centimeters of lead measuring over an inch thick before they are absorbed.

In the treatment of cancer and in the removal of useless tissue, for which radium has been found chiefly valuable in medical science, only the gamma ray is used. Sheets of metal are placed between the patient and the radium to shield him from the alpha and beta rays, which are likely to cause dangerous and painful burns. Thus the surgeon makes use of only about 1 per cent of the tremendous energy given off by the radium. When used in luminous material, however, the energy of the radium is 100 per cent useful.

Although the medical uses for radium were first to be discovered and investigated and the state of that art is, of course, much further advanced than the application of radium to luminous material, it would be difficult to say which of these uses is most valuable to mankind.

Does radium accomplish more good for a woman, for instance, if it saves her life by the elimination of a cancerous growth, or if the unfailing light of a radium indicator simply saves her at night from taking a bottle of poison from a shelf by mistake? Who can say but that thousands of lives were saved during the war because the mariner could steer his ship in utter darkness through submarine-infested seas with the aid of instruments illuminated by radium? How many air pilots have already been saved from death because the steady glow of radium-lighted instruments were the one thing on the "ship" that never went wrong? And who can estimate the value to the airmen of the future? What of the miner, hundreds of feet beneath the surface of the earth, who is warned away from deserted passages and dangerous spots by radium-lighted signs that neither go out nor create an additional fire menace?

In a word, the only real concern we need to have about our supply of radium, either for medicinal uses or in industry, is a future source of ore. In this connection it may be recalled that in the early days of the oil industry it was thought that practically all the oil in this country was in the state of Pennsylvania. Just as oil was discovered over wider and wider areas as the demand for it grew, so radium-bearing ores have been found to supply the demand for the product. It is very reasonable to suppose that there are in addition to the present ample supply, many other radium-ores of which we know nothing, scattered throughout the world, and which will insure an ample supply for many years to come.

The Battleship and the Junk Heap

(*Continued from page 312*)

short distance from the water; if too high the tail of the torpedo, carrying the delicate Obry gear, will be smashed and the torpedo will not run true; (2) the plane must be pointed in the right direction to hit the target; (3) the plane must be at a certain definite angle to the water or the torpedo will go to the bottom; (4) the fighting planes from the fleet will be attacking the torpedo planes, and (5) *most important of all*, the secondary batteries of the fleet and improved destroyer anti-aircraft guns will be firing at the attacking airplanes all the time during which they are attempting to fulfil the exacting conditions noted above.

It may well be that progress in aircraft and submarine design will keep an enemy battle fleet further from one's own coast but, after all, in any except a European war, the sea power—which I hold to be the guns of the fleet—must be sent to the vital strategic area in order to bring its influence to bear in ending the war.

Now if the Briton is to control from the air, he must be able to send his airplane torpedoes to the vital sea area. In the present stage of development he must send them in ships, and all an enemy sea power needs to do is to find some means to destroy the airplane-carrying ships. That should be easy.

In the rapid development of all kinds of weapons of war the world has done wonders in the past half century. In this development every nation has been forced to meet type with type. If England is to be considered America's most probable enemy (which God forbid); if she goes heavily into construction of airplane carriers and relies solely on war in the air, then we must meet her, not only by some weapon to destroy her airplane carriers, but by war in the air. If some other nation holds fast to the battleship we must meet her by power on the surface. Again, if any nation, whose policies clash with ours, lays great stress on the submarine, Uncle Sam must be fully prepared to combat the submarine. This has been proved in the past when the torpedo-boat brought forth the design of the destroyer, and the armored cruiser was met by the faster, heavier gunned battle-cruiser.

One of the questions that form the main theme of the writing of the capital ship's principal enemy—Sir Percy Scott—is "What can the battleship do?" The answer comes from one of the underlying principles of sea power. The big gun ship places gun power, the controlling factor of naval strength, in the sea areas where needed. Big-gun superiority forms a point of support for cruisers and other warships and enables them to patrol and control the area in question.

Why Not the Pit Silo?

(*Continued from page 313*)

and second coats. This accomplished, digging may be resumed, the job being finished in sections until the requisite depth is attained—a method of performance eliminating the danger of the caving in of the silo.

As finishing touches to the subterranean container, a wall four feet high is built on the concrete curb, a variety of material being suitable, including concrete, lumber, concrete blocks, hollow tile blocks, or brick. The wall, occasionally constructed of woven-wire fencing, is a barrier to persons or live stock stumbling into the pit. A board roof covering is advisable. Space of two feet or more at the top of the wall for the free circulation of the air minimizes the possibilities of the accumulation of poisonous gases. A lighted lantern, lowered into the pit is used as a detector of gases—the lantern continuing to burn being a token of safety.

Hoisting equipment is a very necessary accessory to pit silos, a device for lifting the ensilage from its resting place and in some instances transporting the succulent material to the feed troughs. Although a major portion of these outfits are home-made, one of the photographs reproduced describes a patented hoisting device in use in the Panhandle area of Texas. The feeder can lift himself and the silage from the pit by an endless rope or chain which is operated over a large wheel near the top of the hoisting outfit. The carrier holding the silage is conveyed to the hooks on the trolley and thence transported to the feed trough. A framework similar to this one invites the installation of a horsepower hoist or a hand windlass.

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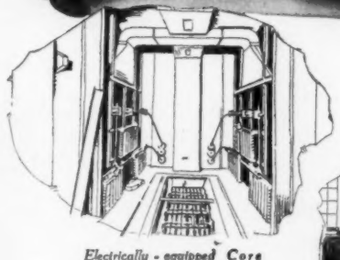

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